







Starrett®
No. 673
THE L.S. STARRETT CO., ATHOL, MASS.



USE FIN
HOLES TO LIFT
TOOL OFF BASE

































Welcome Everyone with the slightest feeling of curiosity

THIN



KEEP OFF
LIVE WIRES

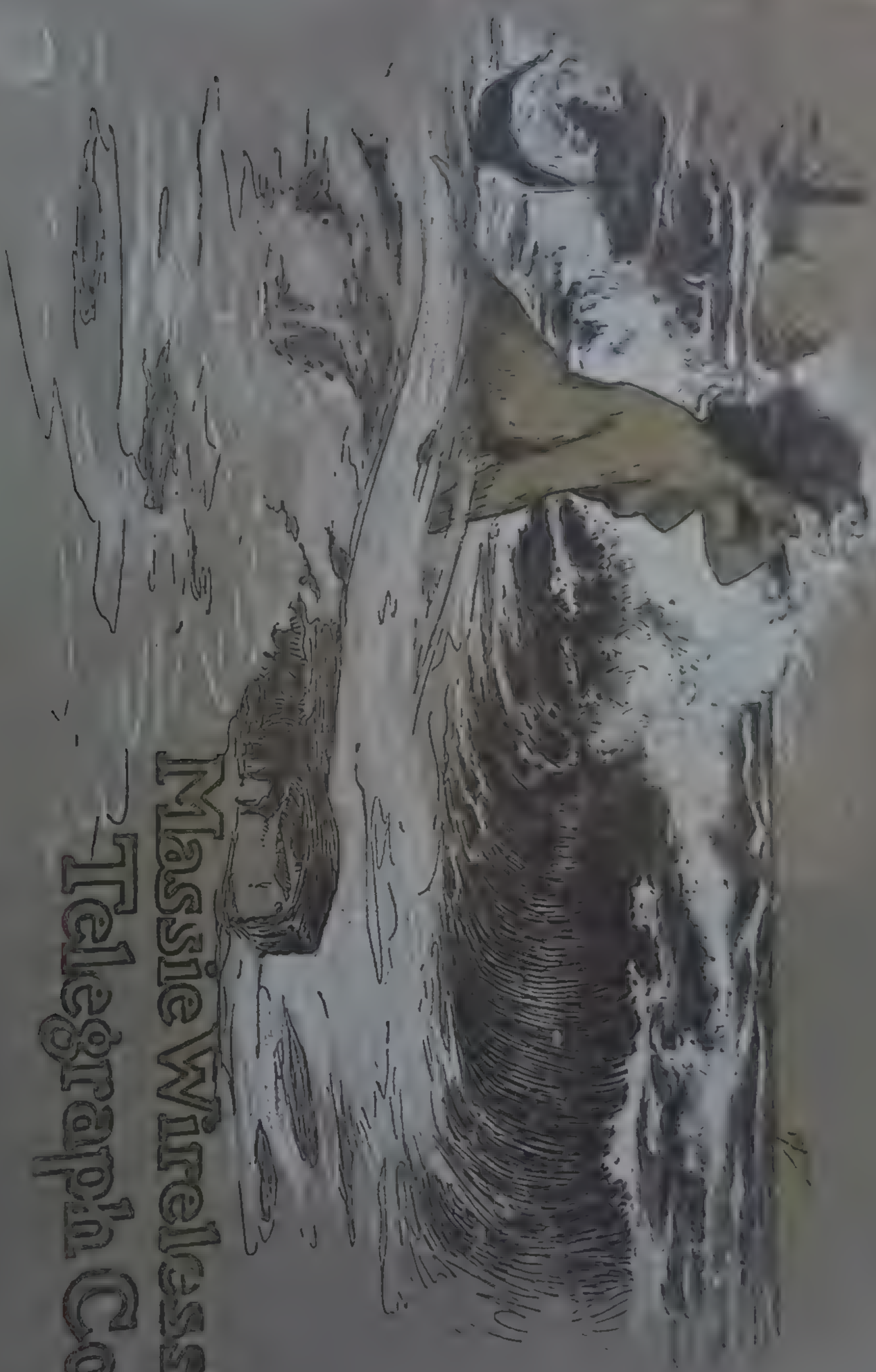
MESSAGES ACCEPTED
FOR TO
All Sound Steamers
Massie Wireless Telegraph

PJ
MASSIE WIRELESS STATION
CALL LETTERS "PJ"
BUILT AT POINT JUDITH B.C.
IT IS THE ONLY WORKING
WIRELESS STATION IN THE WORLD
MOVED TO THIS SITE BY ADULTS IN

DANGER
RADIO
FREQUENCY
HAZARD
Dangerous to
pacemakers.

"DAS SENDINGMACHINEN IS NICHT FÜR GERINGER POKEN UND MITTEN-
GRABEN. IS EASY SCHNAPPEN DER SPRINGENWORK. BLOWENFUSEN, UND
POPPENCORKEN MIT SPITZENSARKEN. IS NICHT FÜR GERWERKEN BY DAS
DUMMKOPFEN. DAS RUBBERNECKEN SIGHTSEEREN KEEPEN DAS HANDS IN
DAS POKETS. RELAXEN UND WATCH DAS BLINKENLIGHTS."

Missie Wireless Sales and
16 WINNERS ROAD, EDGEMOOR, N. I.



Missie Wireless
Telegraph Co.

The New England
Steamship
Company

The New England
Steamship
Company

1916 AMATEUR RADIO HIGH
POWER SPARK COIL BUILT
BY LARRY WAGNER, W3AAY

HAS A SALE

PERIOD THURSDAY FRIDAY AND SATURDAY

FOR SELECTED
ASSORTMENT OF
KID'S HAND

TOYS
49¢

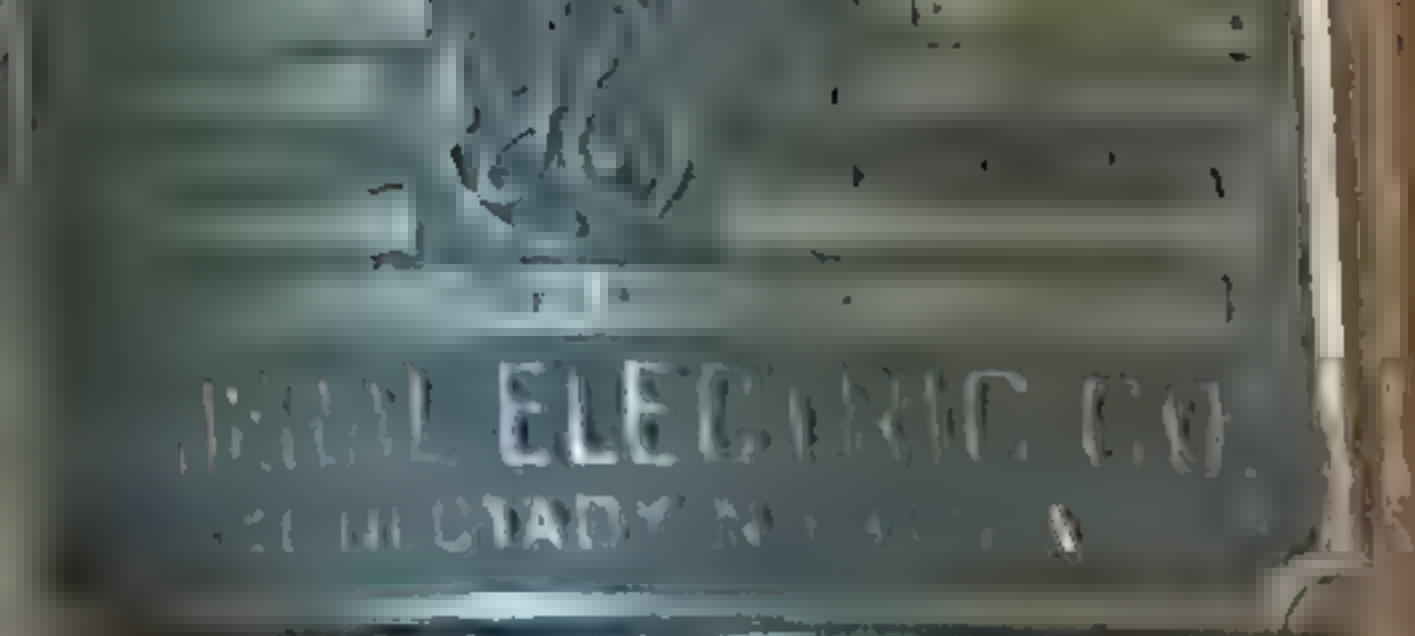
AT THE ERWIN STORE



EDISON

KILBOURNE & CLARK
SEATTLE 1918
2kW X-RAY STANDARD
QUARTZ TRANSMITTER
AND CONTROL PANEL

DANGER
HIGH VOLTAGE



WESTINGHOUSE ELECTRIC CO.
100 HUNTSVILLE, ALA.



ARTHUR C. GOODNOW - WIRELESS MAN
FROM SPARK TO SATELLITE

1988
This Room Is Dedicated
To
ARTHUR C. GOODNOW, WIDM
1908 - 1988
Former Museum Trustee,
Chief Transmitter Engineer
For Westinghouse Group W,
Eminent Radio Historian And The
Recognized Authority On Spark Transmitter Design.
His Career Spanned
From Spark To Satellite.



TELEFUNKEN QUENCHED GAP
Gift of Arthur Goodnow, WIDM
ARTHUR C. GOODNOW, WIDM COLLECTION





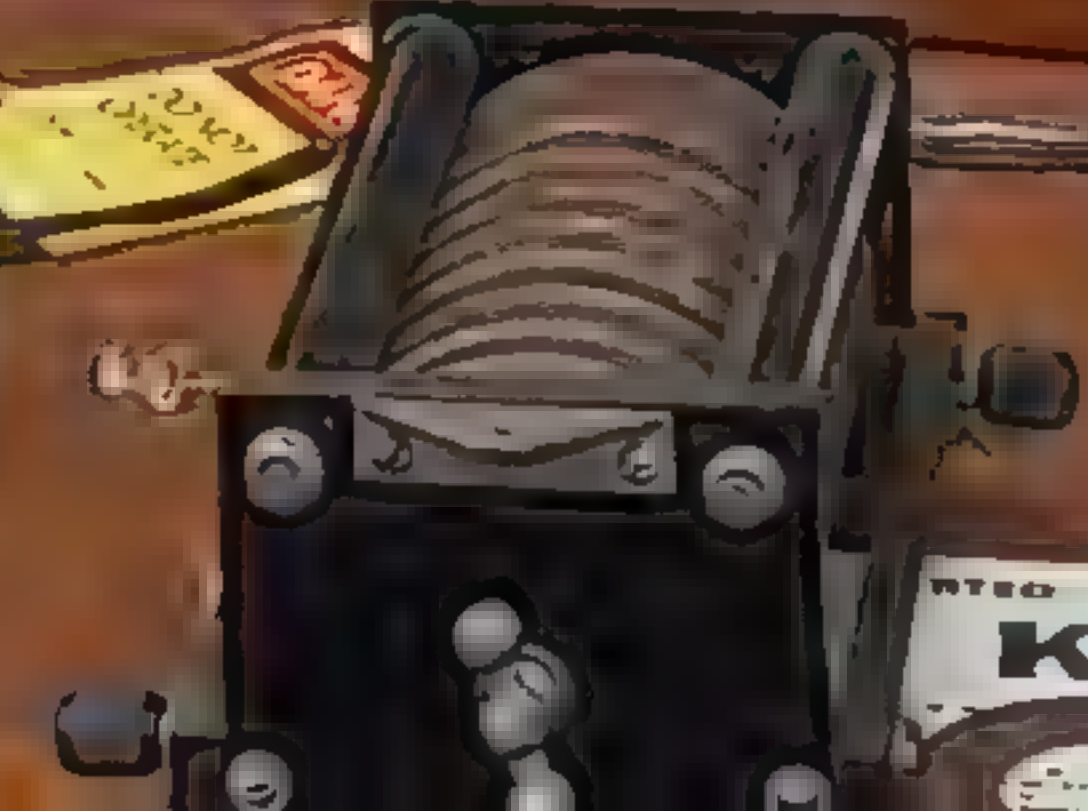
AMRAD QUENCH D GAP
GIFT OF THORN MAYS, W6AA





DANGER
HIGH VOLTAGE

NOTICE
ELECTRICAL
AREA



UNITED STATES OF AMERICA
K2TO



UNITED WIRELESS
TYPE D TUNER
GIFT OF
N. VANCE PHILLIPS
W6GH

SPARK TRANSMITTERS





ELECTRICITY
KEEP OUT

TUSC
TIVON

VARIABLE COUPLING SCALE

WYATONE TRANSMITTER
100-500 WATTS
CLASS - EASTMAN CO
CAMBRIDGE MASS
PATENTED



Reconstructed by
CDR. RICHARD SMITH
WINHO

RADIO
1/2 KW
D C

WATTS OF POWER
WATTS OF POWER

EDISON'S 1879 ETHERIC FORCE DETECTOR.
16 YEARS BEFORE MARCONI'S FIRST TRIES
REPLICA MADE BY COLIN LEATH, K11X1



HYDRONIC TRANSMITTER
110V 60W 500 WATTS
CLAPP-EASTMAN CO
CAMBRIDGE MASS
PATENTED

GIFT OF
JOSEPH J. DE SOUSA WIOFA

Reconstructed by
CDR. RICHARD SMITH

of the estate of
D. CARDWELL

OFFICE
EPH J DE SOUSA WIDEN



HYTONE TRANSMITTER
110V 60-300 WATTS
CLAPP-EASTHAM CO.
CAMBRIDGE MASS.
PATENTED

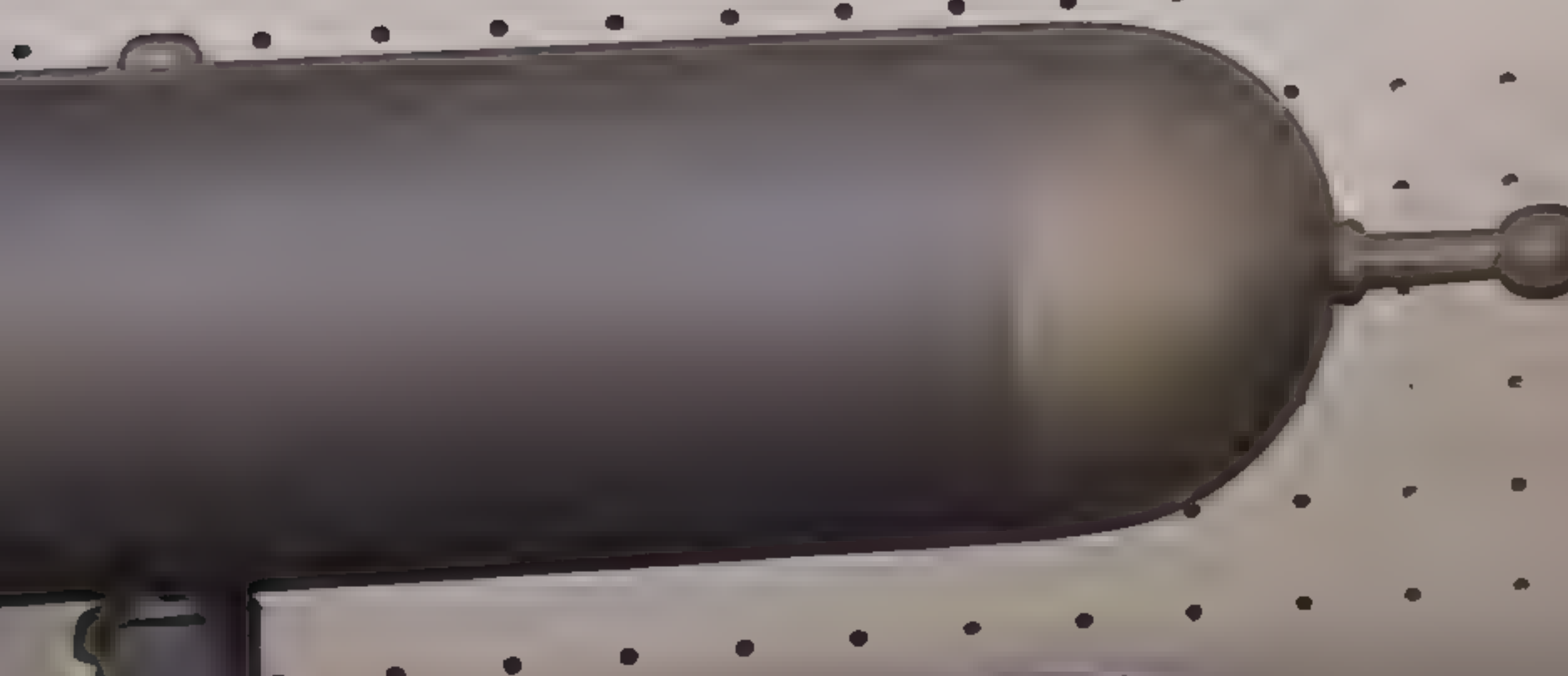
CLAPP-EASTHAM
500W BATTERY
GIFT OF ERH J. DE SOUSA, W10FK

Reconstructed by
CDR. RICHARD SMITH
WINHO



AMIN FRANKLIN
CIRCUIT BELLS

DETROIT 1900





WILLIAM GILBERT'S
MAGNETIC CIRCLES
1836

WILLIAM GILBERT'S
MAGNETIC CIRCLES
1836

BENJAMIN FRANKLIN
ELECTRIC BELLS

BENJAMIN FRANKLIN
ELECTRIC BELLS

BENJAMIN FRANKLIN
ELECTRIC BELLS



BEFORE 1900

**NO
SMOKING**









CURRENT

STONE TRANSMITTER
10V 60A 500 WATTS
CLAPP-EASTHAM CO
CAMBRIDGE MASS
PATENTED

DANGER
HIGH VOLTAGE

JUSTICE
ELECTRICAL
DEPT



RADIATION CURRENT

EASTHAM TELESCOPE
COLLECTION
OF
1900-1910

HYTONE TRANSMITTER
110V 60-500 WATTS
CLAPP-EASTHAM CO.
CAMBRIDGE MASS.
PATENTED

LINE

MAIN LINE
SWITCH

KEY

CLAPP
EASTHAM
BOSTON

HYTONE TRANSMITTER
110V 60 500 WATTS
CLAPP-EASTHAM CO.
CAMBRIDGE MASS
PATENTED

MAIN L
SWITCH

KEY

GIFT OF
JOSEPH J. DE SOUSA, W10FK





THE FIRST
COHESIVE
...

AWL
...

...

A. W. L.
UNIVERSAL COIL
OELLING & HEINZE
1001 MASSACHUSETTS
BOSTON, U.S.A.

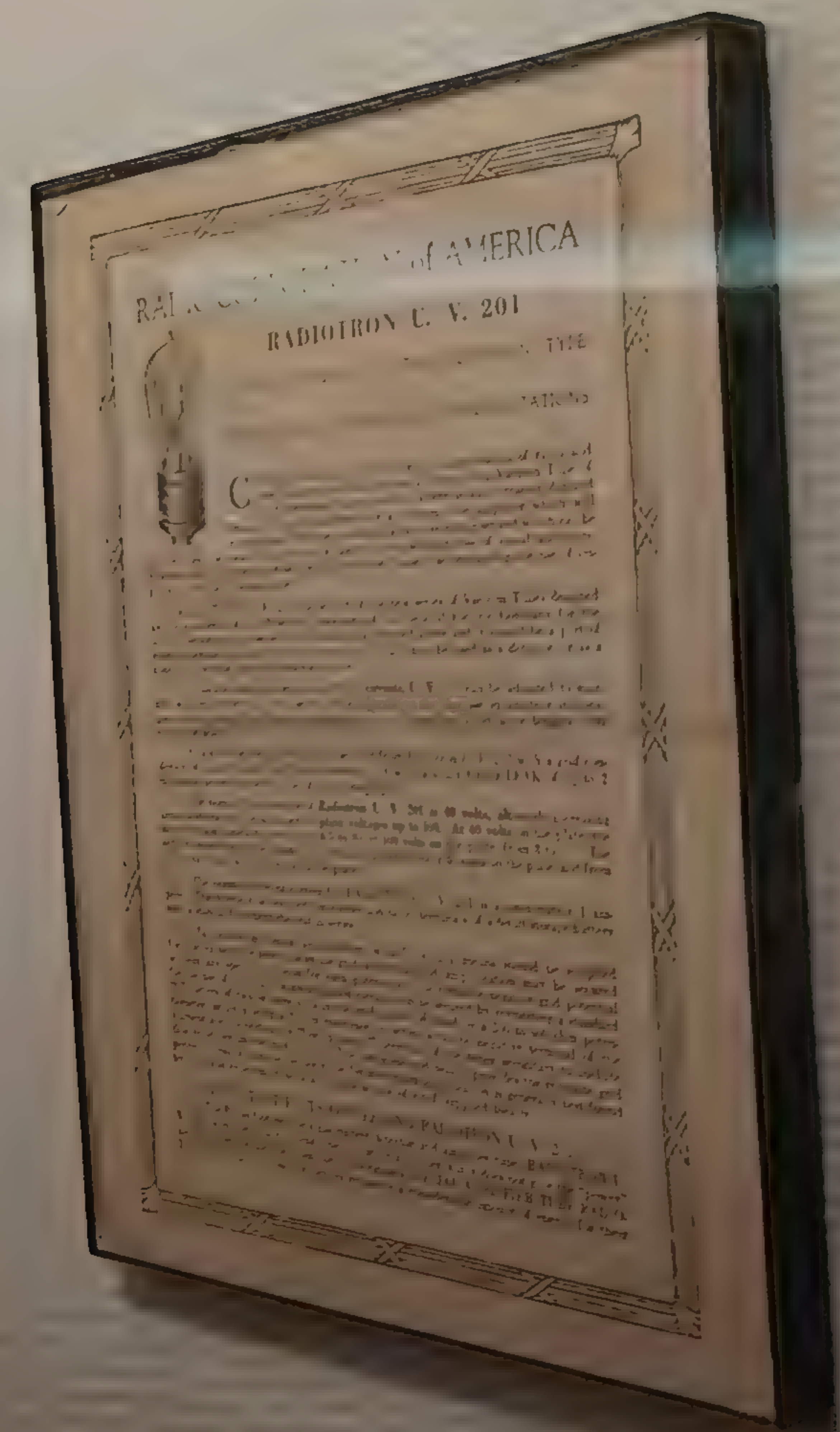
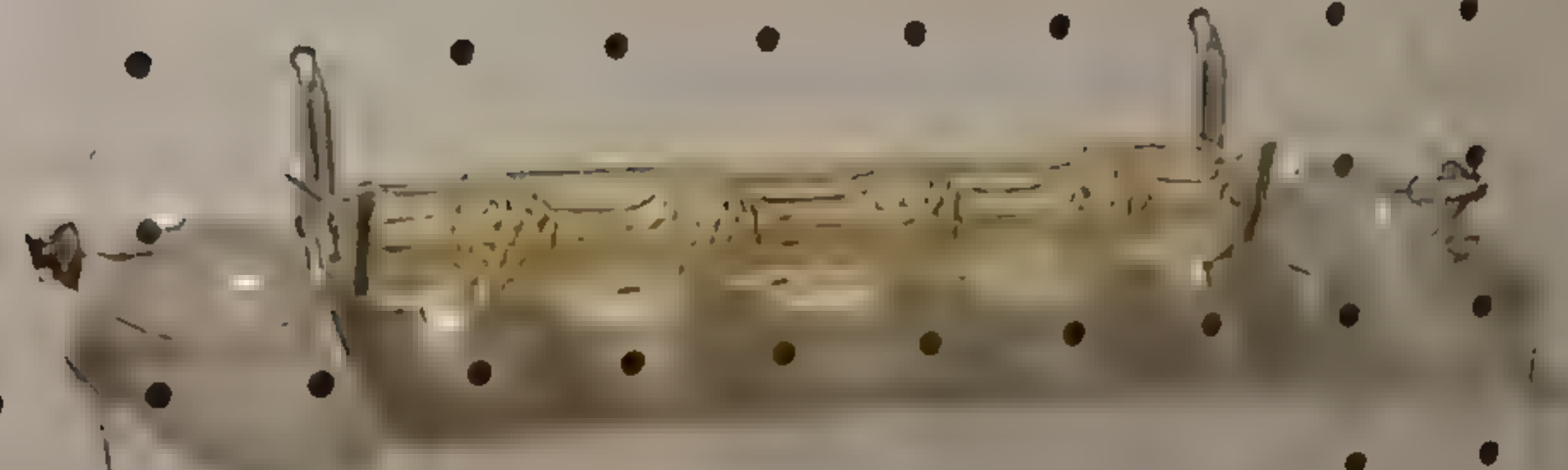


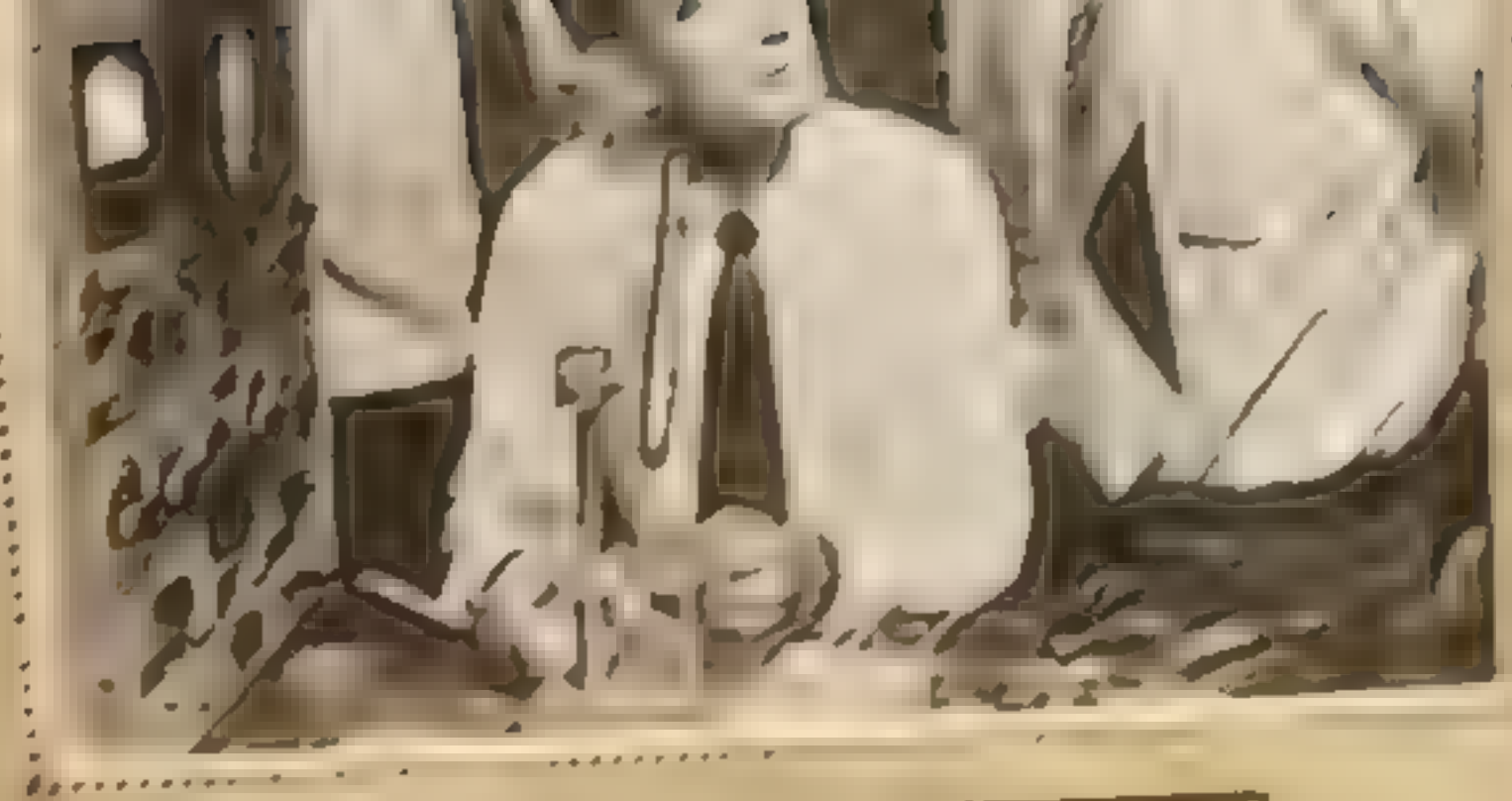
A.W. 1
UNIVERSAL CRIB
OETTING & BRUNZ
NEW HARTFORD CT. U.S.A.

8 in. ACBL-1335

P164

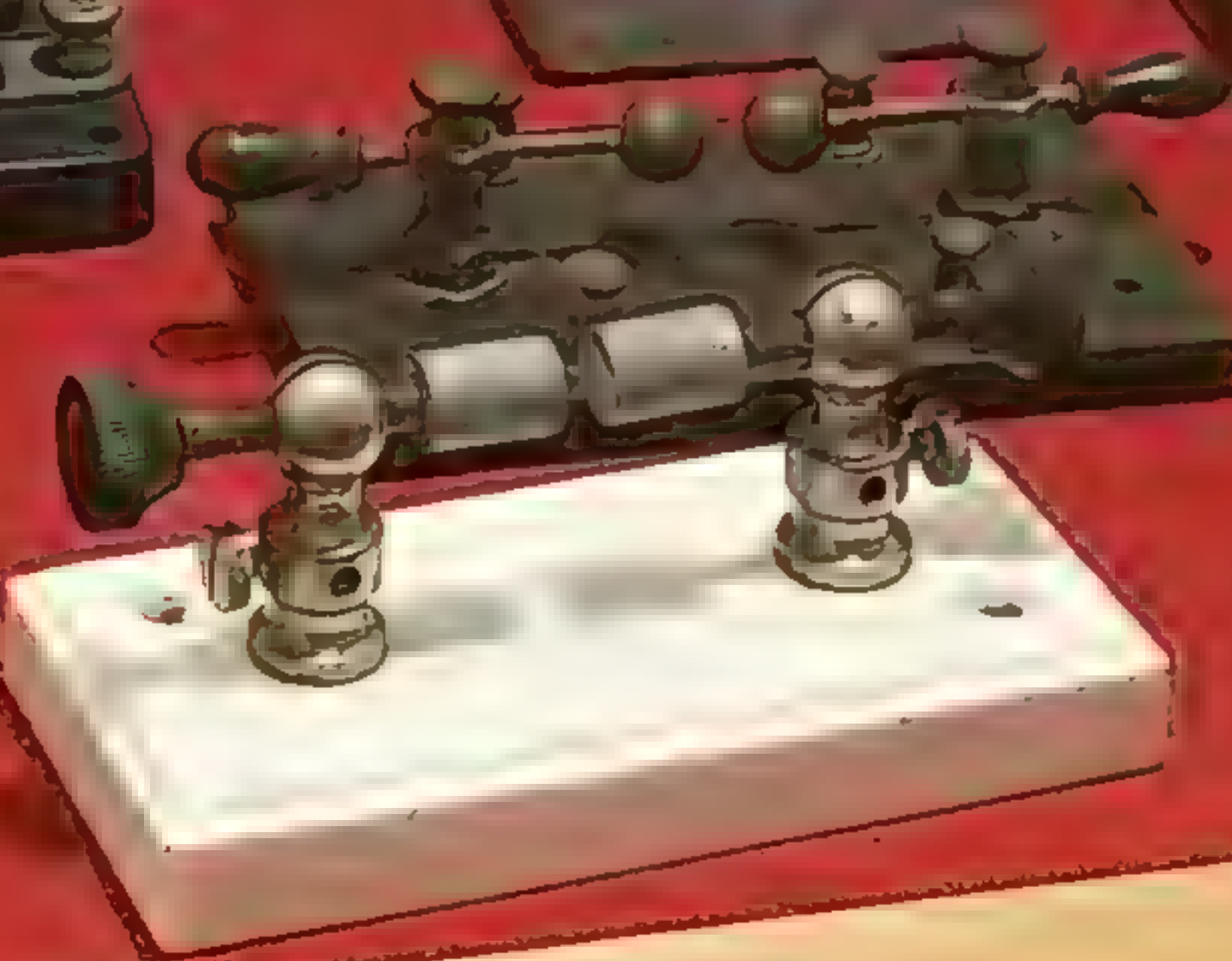
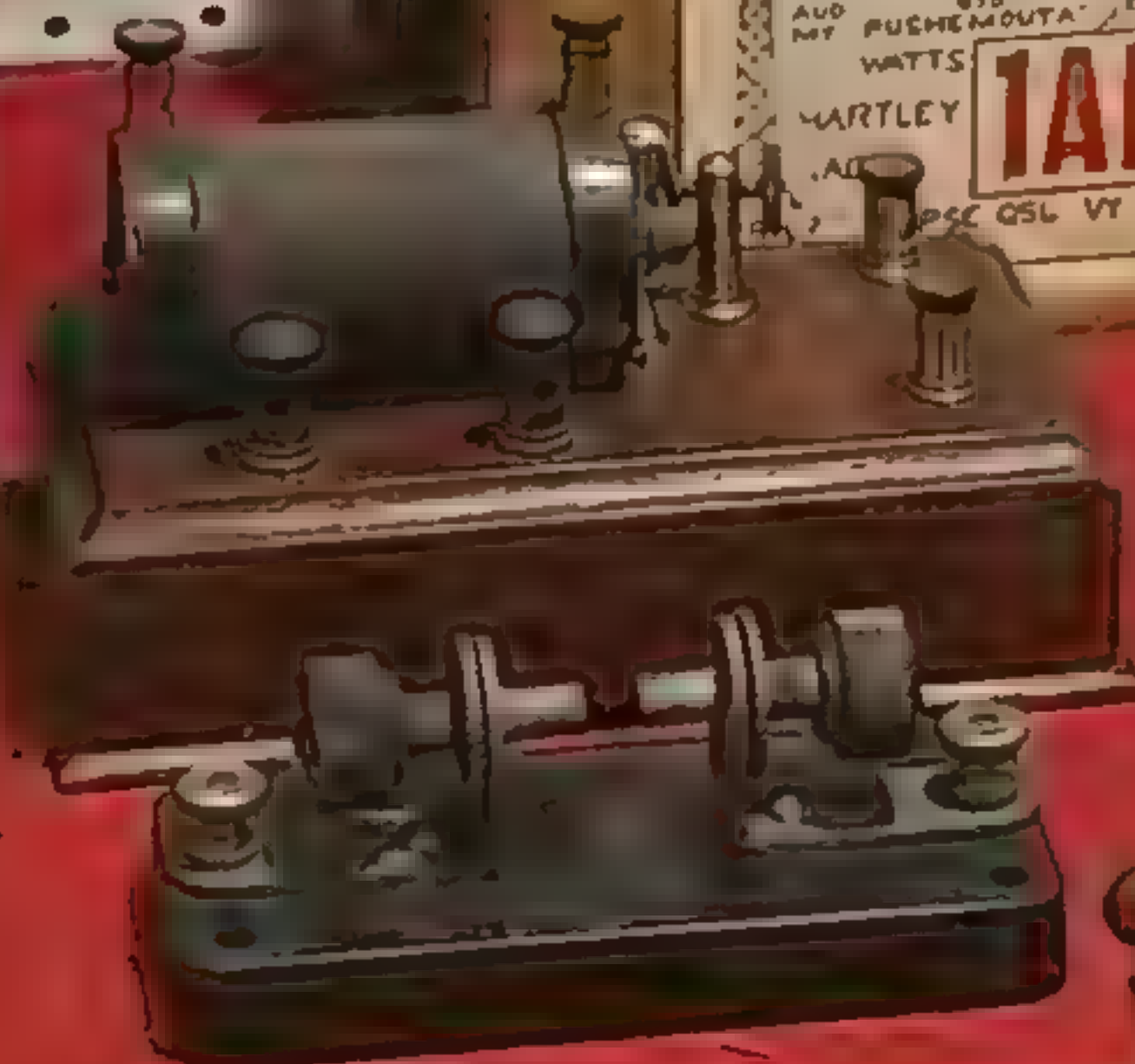
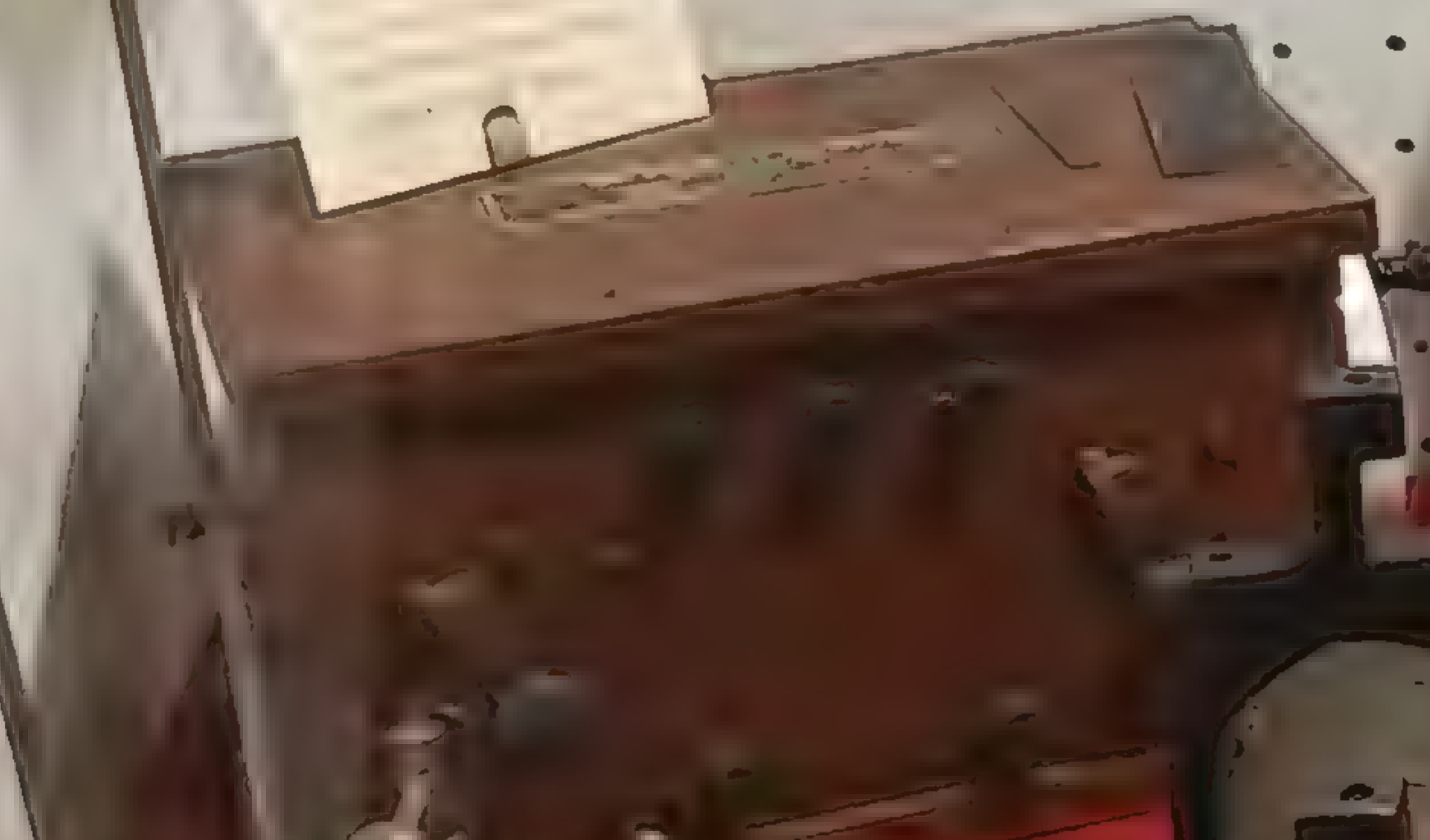
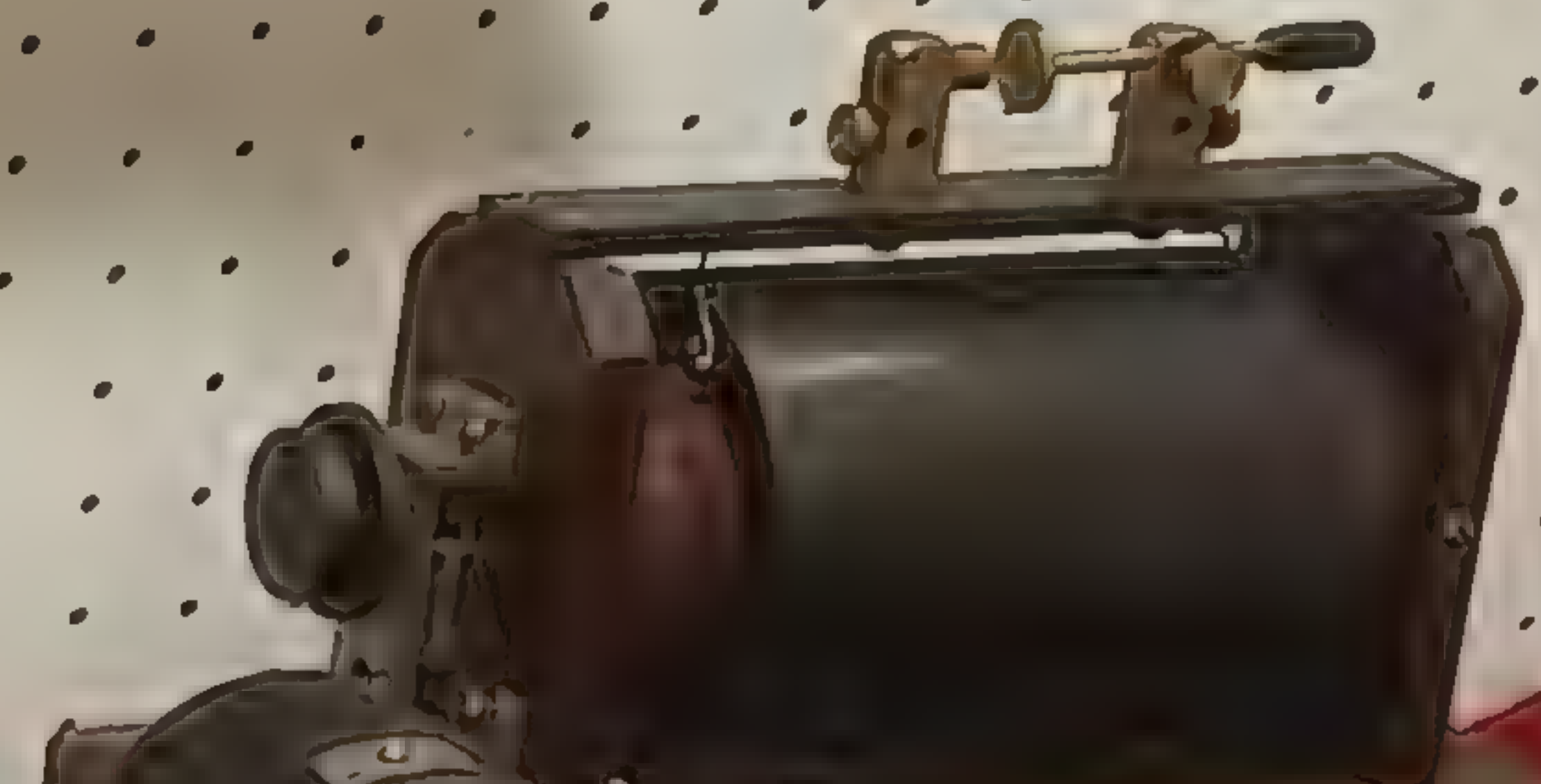
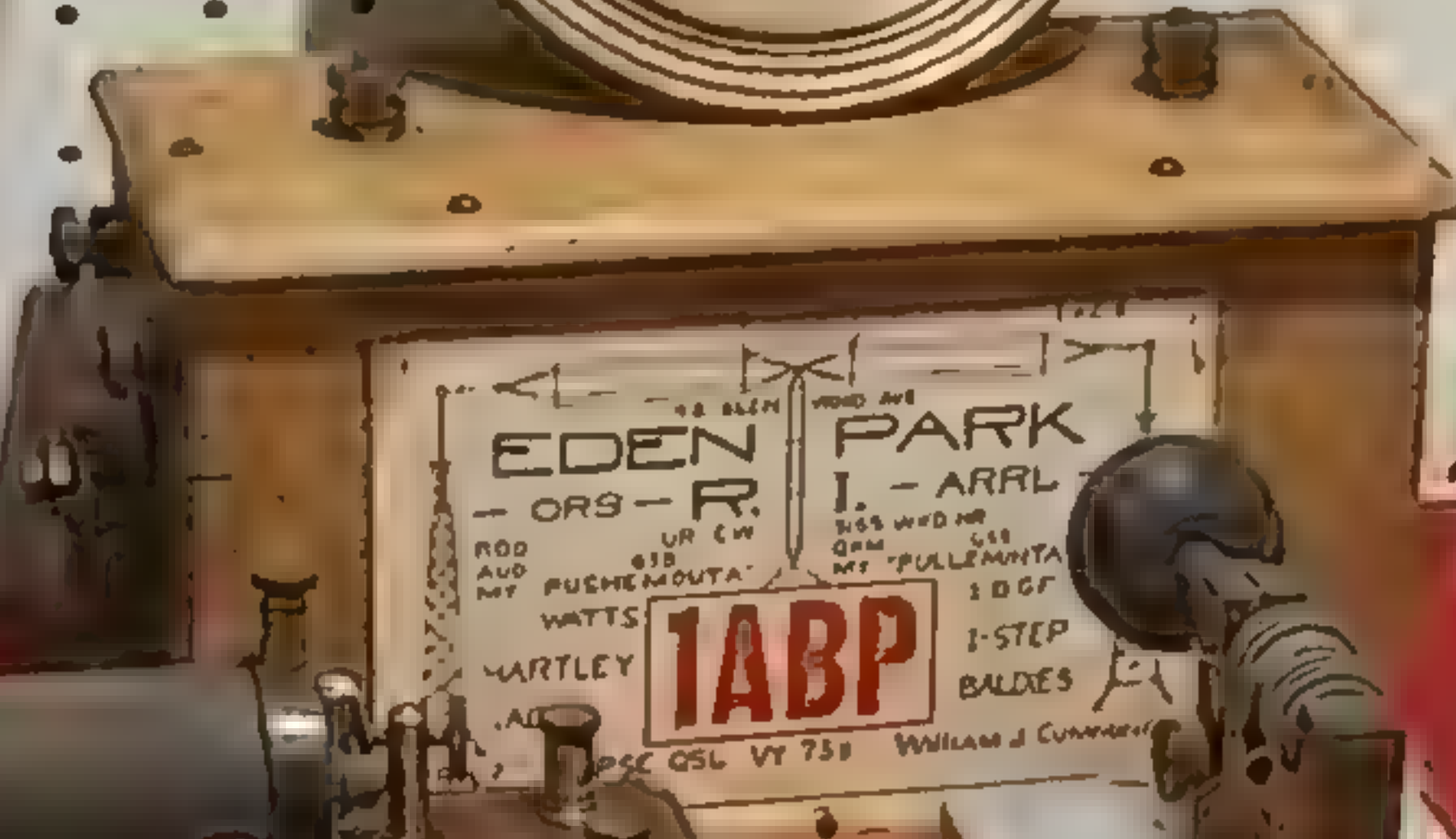




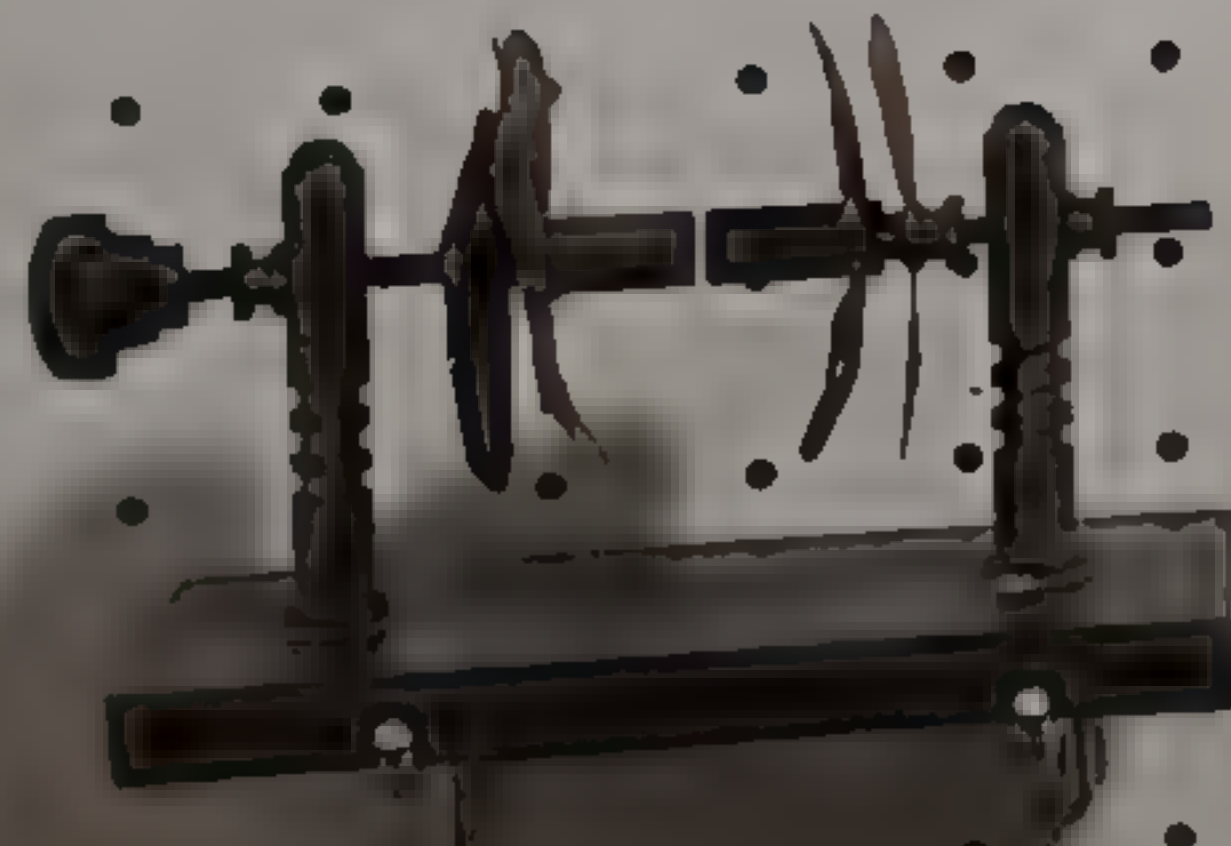


UNDERSTANDING
AND IMPROVING
CREATIVITY





Gift of Mrs. Albert Savage
in memory of her brother
LEN LUTHER NIXON





ROTARY SHUTTER
FOR 500 CYCLES PER SECOND
MADE FOR NAVY DEPARTMENT BY
LOWENSTEIN OPT. CO. 1100 N. 10TH ST.
PHOTO. & 54 CONT. NO. 38376 PHOTO. &
GEN. SE 64 SERIAL NO. 17768
SERIALS 17768 TO 17770







EDISON MACHINE WORKS
BUILDERS
NEW YORK U.S.A.
8

EDISON MACHINE WORKS
BUILDERS
NEW YORK U.S.A.
8













FITCHBURG STEEL LATHING CO.
FITCHBURG, MASS. U.S.A.

MODEL	NO.	DATE	BY
100	1	1910	J. H. B.
100	2	1910	J. H. B.
100	3	1910	J. H. B.
100	4	1910	J. H. B.
100	5	1910	J. H. B.
100	6	1910	J. H. B.
100	7	1910	J. H. B.
100	8	1910	J. H. B.
100	9	1910	J. H. B.
100	10	1910	J. H. B.













STREET NO. 1

MARCH 2, 1889.

THE ELECTRICAL WORLD.

v

THE THOMSON-HOUSTON DYNAMO FOR ARC LIGHTING

IS UNEQUALED IN

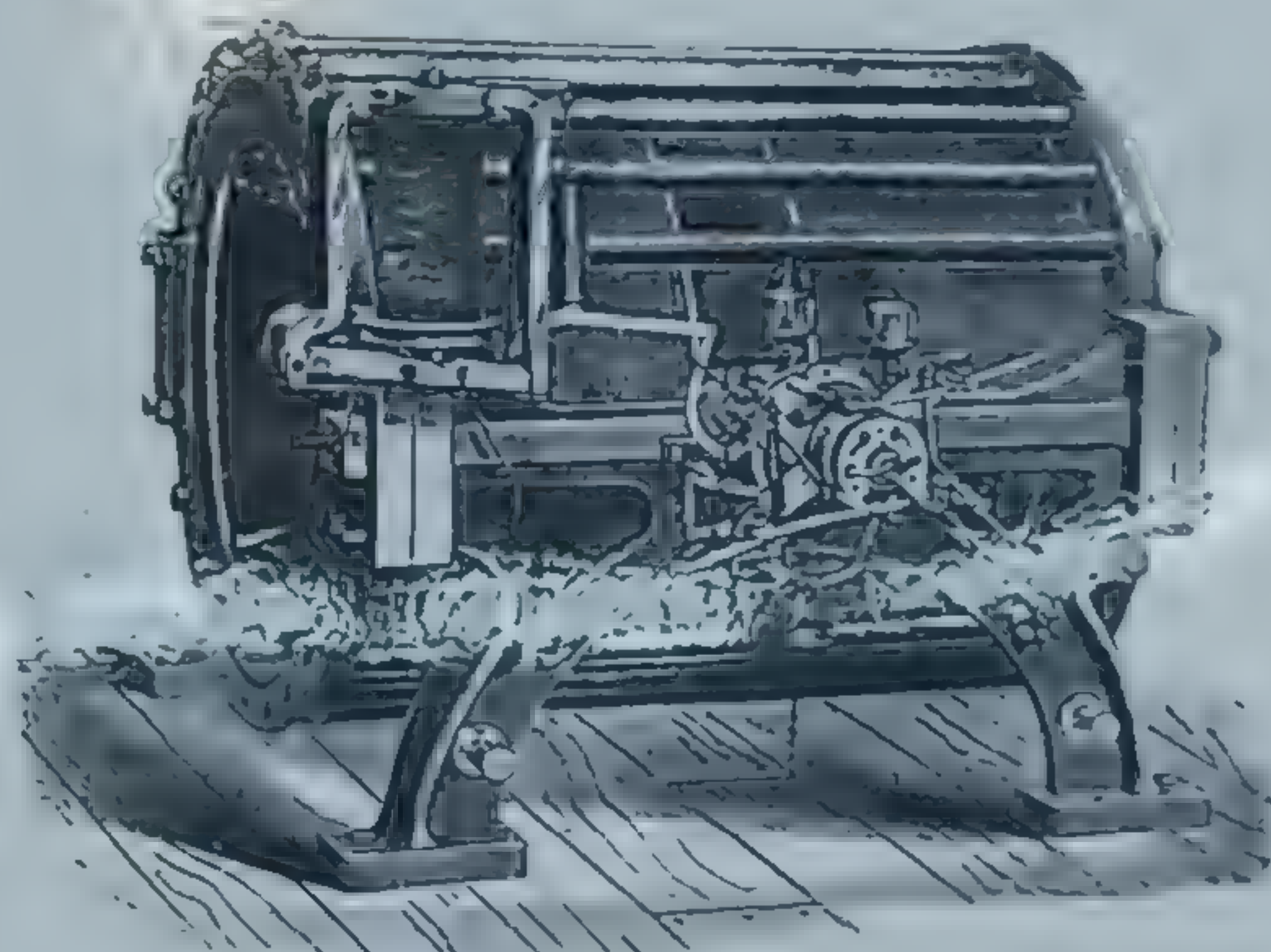
Economy of Operation and Automatic Regulation.



SERIES INCANDESCENT LAMP

One of the most important features of the Thomson-Houston System of Arc Lighting is the facility with which Arc and Incandescent Lamps can be operated from the same dynamo and upon the same circuit, thus rendering it possible for local companies to supply both forms of light without use of a separate dynamo.

More than
400
Local Companies
using this
system.



Thomson-Houston Dynamo for Arc Lighting.

More than
50,000
ARC LAMP
in daily
operation.

THE THOMSON-HOUSTON LIGHTNING ARRESTER,

For use with Arc Dynamos, insures absolute protection of the apparatus from all danger of Lightning Discharges. The Thomson-Houston patents cover all practicable forms of Lightning Arresters for Arc and Incandescent Lighting Circuits.

THE THOMSON-HOUSTON ELECTRIC COMPANY,
The Hathaway Building, 620 Atlantic Avenue, Boston, Mass

115 Broadway, New York.

Kimball House Building, Atlanta, Ga.

503 Delaware Street, Kansas City, Mo.

148 Michigan Avenue, Chicago, Ill.

Globe Building, St. Paul, Minn.

234 Montgomery St., San Francisco, Cal.



ARC LAMP.









WESTERN
ELECTRIC
COMPANY

CHICAGO—NEWYORK

TYPE ELA01S K.W. 6

NO 35128 SPEED 1800

VOLTS 110 155 AMP 8.5

VOLTS NO LOAD 110
FULL LOAD 105



WESTERN
ELECTRIC
COMPANY
CHICAGO - NEW YORK







Manufactured
1910

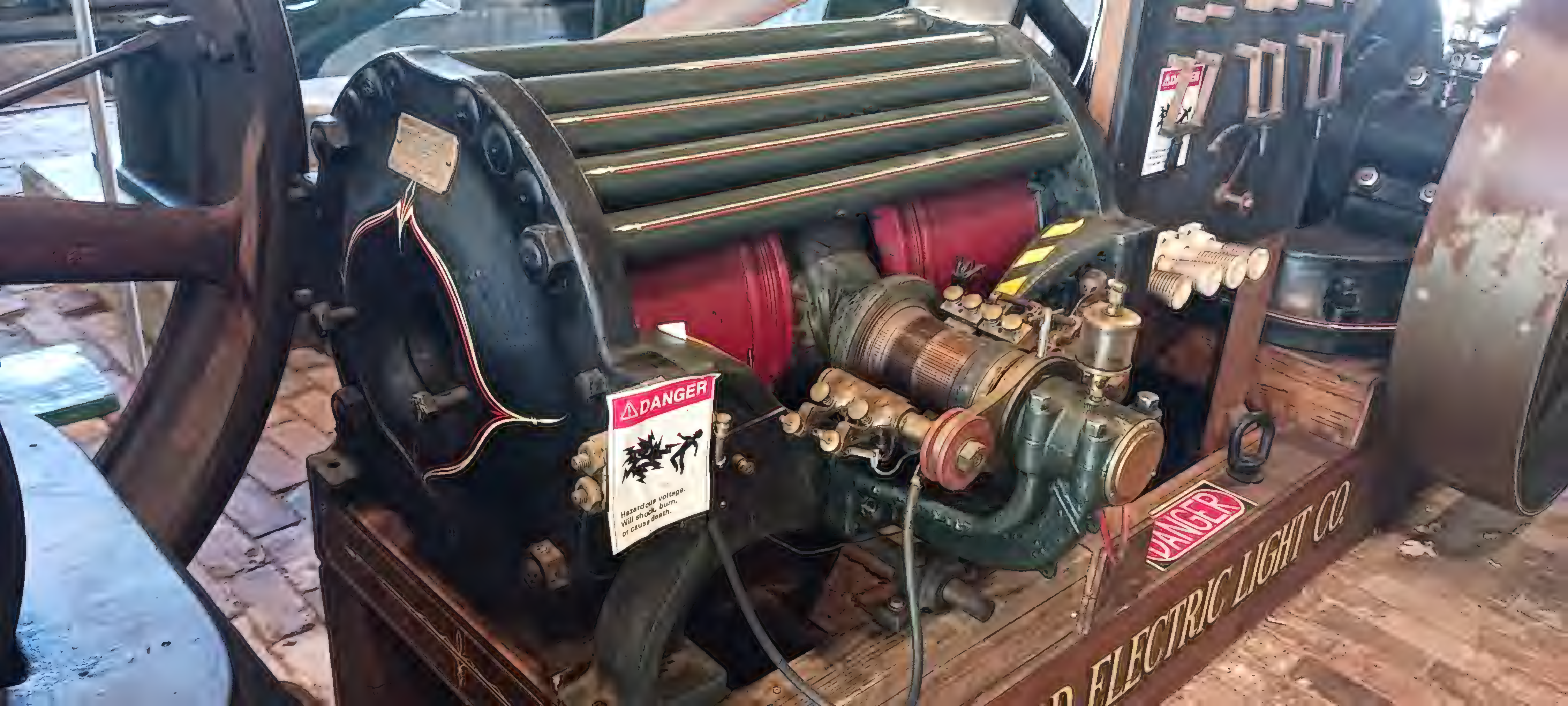
**THOMSON-
HOUSTON
ELECTRIC CO.**


SERIAL NO. 78

STATED CAPACITY
28 LIGHTS

CLASS E-1





⚠ DANGER

Hazardous voltage.
Will shock, burn,
or cause death.

EDISON ELECTRIC LIGHT CO.



THOMSON INCANDESCENT DYNAMO

PATENTED SEPT 2 '78 - OCT 5 '80

OCT 10 '82 - JAN 5 '86

PATENTS APPLIED FOR

MANUFACTURED BY

THE THOMSON-HOUSTON ELECTRIC CO.

CLASS E 1

No. 78





Manufactured by
**ARMINGTON
SIMS CO.**
PROVIDENCE, R.I.
BUILT IN 1883
SERIAL NO. 1469
50 H.P.
FULLY DEMONSTRATED
1883

The HARTFORD

HOWARD & SONS
IRON WORKS
CAMBRIDGEPORT

AUTOMATIC REGULATOR NO. 1
PATENTED - JAN. 20 '80 - MAR. 1 '81 - DEC. 26 '82 - FEB. 6 '83
THOMSON-HOUSTON ELECTRIC CO.
LYNN, MASS. U.S.A.

MANF BY
THIELEC CO.







A. W. L.
UNIVERSAL COIL
OELLING & HEINZE
SOLE MANUFACTURERS
BOSTON, U.S.A.

GIFT OF
INLOWE UNIVERSITY





THE SPECTROSCOPE IN USE

When the light waves from any flame are passed through a glass prism, certain definite lines are seen in the spectrum produced, and by means of these we can detect very small quantities of matter, and distinguish one elementary substance from another. It is by this means we have learned the constituents of the heavenly bodies.

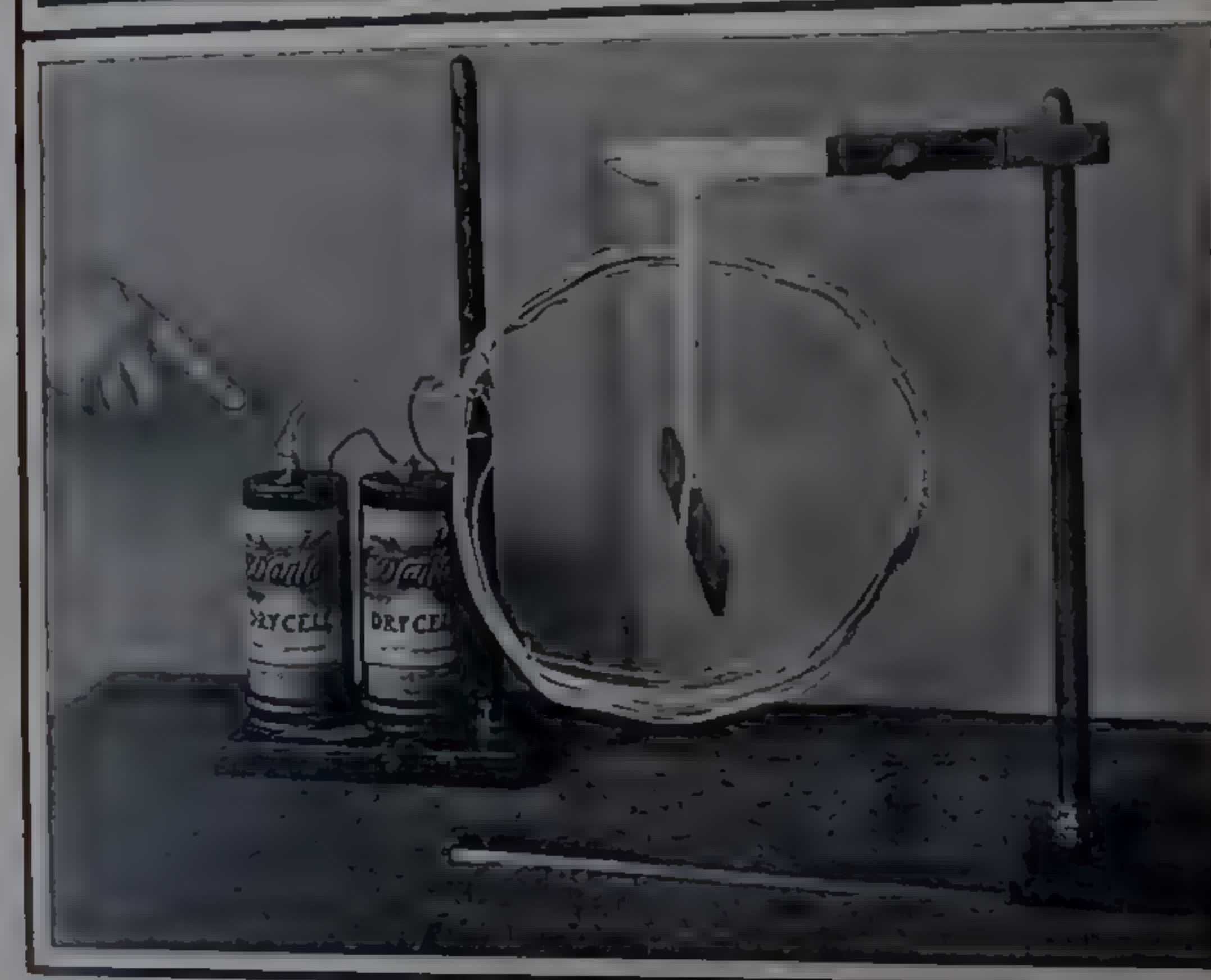
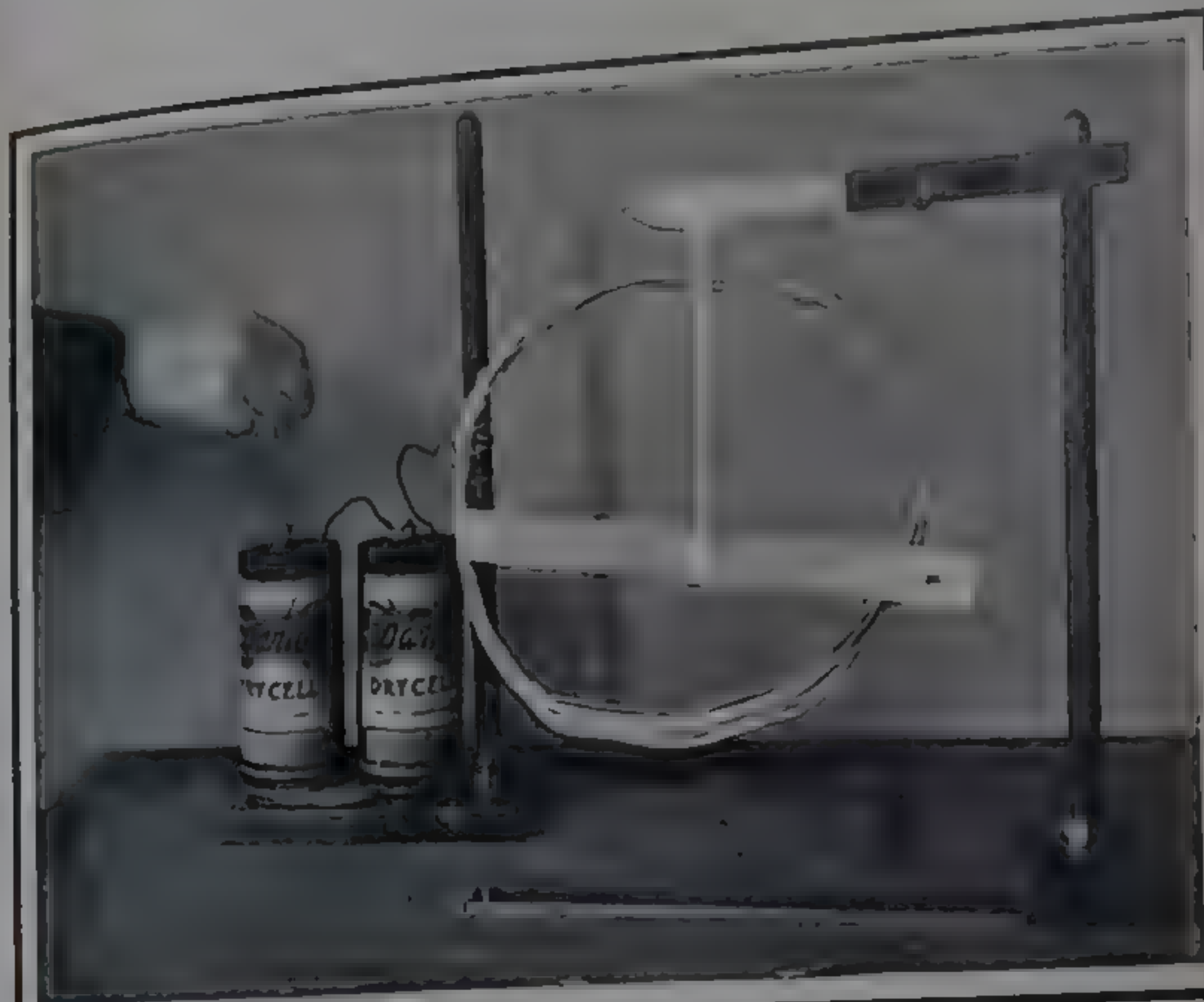
Scientific Ideas of To-day

disturbance which, at some great distance, is again transformed into the vibratory motion of other particles of matter.

When we speak to a distant friend by telephone, it is obvious that no sound passes from the one town to the other. The sound produced by the speaker controls an electric current which passes out to the distant station, and there it sets a metal diaphragm in motion, which causes the surrounding air to vibrate and reproduce the distant controlling sound. Just as no sound passes between the two distant places, no heat passes between the Sun and the Earth. In both cases there is a real transformation and reproduction.

It is only at the outset that the novice shakes his head at any mention of the æther. His first inclination is to say that we might as well talk about "the man in the moon." He may say that scientists have merely invented the idea of the æther to help them out of difficulties. The scientist admits the accusation. The idea of the æther was suggested by a great Dutch philosopher, Huygens,¹ more than two hundred years ago, to explain the phenomena of light. Sir Isaac Newton's more materialistic theory was much more popular, and even when the original philosopher, Dr. Thomas Young (London), adopted and worked out this æther idea, he met with little encouragement from scientific men. It is amusing to turn to an old number

¹ Long before this time æthers had been invented for the planets to swim in, and indeed to help the ancient philosophers out of any apparent difficulty, but the æther as we now accept it was definitely suggested by Huygens at the close of the seventeenth century.



A COIL OF WIRE CARRYING AN ELECTRIC CURRENT BEHAVES LIKE A MAGNET

In the upper illustration the battery is not connected to the coil. When the circuit is completed the large steel magnet swings round and takes up a position at right angles to the face of the coil, as in the lower photograph.

...of To day
 electrons to any other atom. We picture the atom as being below it in the scale. We picture the atom as being capable of accepting electrons to become negative, for it will then have surplus electrons. The atom losing electrons will represent the electro-positive atom. We picture a certain kind of atom giving electrons to another atom lower down in the scale, and we say the former is electro-positive; but at the same time we see that this same electro-positive atom is able to accept electrons from another kind of atom which is still higher in the scale, and in this case it is no longer electro-positive, but becomes electro-negative.

While the foregoing analogy may be of some assistance, it is not complete. For instance, it does not take into account the fact that two atoms of the same element—say oxygen—unite together to form a molecule of oxygen. Our analogy would suppose that because both atoms are on the same level on the scale neither could throw electrons at the other. The physicist can adduce reasons, however, for supposing that when two atoms of the same element come so near together that the revolving electrons in the one atom can exert force upon the revolving electrons in the other, there is an interchange of electrons which causes one of the atoms to become electro-negative to the other. In this way we may still picture two atoms of oxygen as being electrically united to form a molecule of oxygen.



ELECTRICAL REPULSION

If a tassel of ordinary sewing silk be briskly rubbed with a rubber tobacco pouch, the silk threads will become similarly electrified and will therefore repel each other, as seen in the lower photograph. The electrified threads will attract any unelectrified body, so that those threads near the upright stand cling to it.



(1) DARK LINES IN THE SOLAR SPECTRUM
(2) ZEEMAN EFFECT

The upper illustration is part of a photograph of the solar spectrum. The meaning of the dark lines which appear in the photograph is explained at page 226.

The lower photograph is a double one. First of all a single spectral line of sodium was photographed. Then a powerful magnetic field was applied to the sodium flame, and the second photograph was taken showing the same line split into two lines. See page 241.

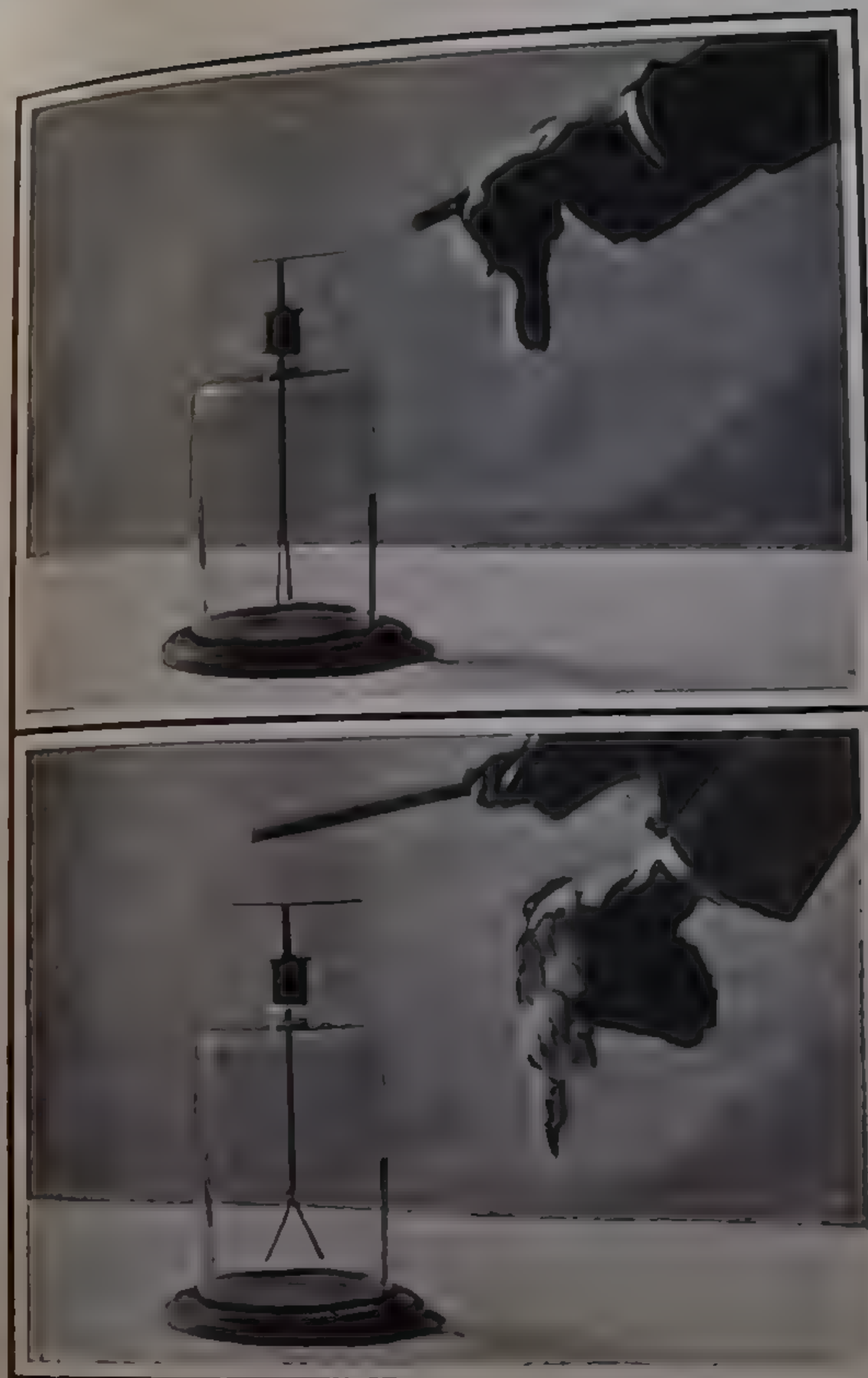
This photograph was taken in the late Lord Blythswood's laboratory.

Scientific Ideas of To-day

number disintegrating per second, we find that a gramme of radium should last about three thousand years. This is only a very rough way of expressing the facts, for, as the radium's volume decreases, it will not lose the same quantity each year. The more it disintegrates the more slowly will the remainder break down. It is because of this law that it is more convenient to say that radium will disintegrate half its atoms in about thirteen hundred years.

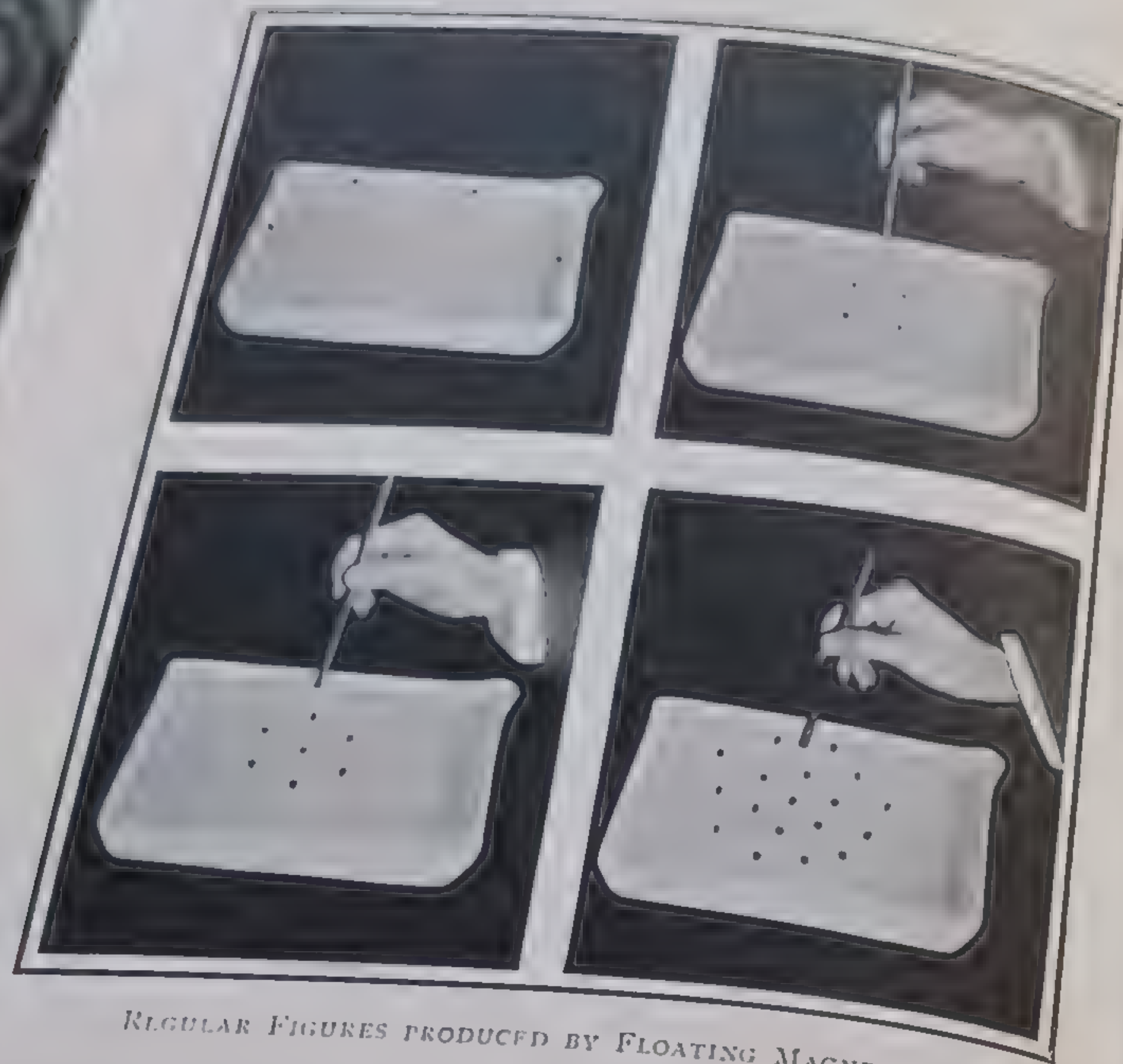
In accordance with the same law we find that although the emanation of radium takes a few weeks to completely break down, yet one-half of it has disappeared at the end of the first four days. Dealing with uranium in the same way, we say that half its quantity would disappear at the end of six hundred million years.

It is interesting to note that these various rates of decay, or disintegration, are constant and can neither be hastened or retarded by man. It would not be wise to be dogmatic and say that man will never be able to hasten the natural rate of disintegration of radio-active bodies. Who could have believed, a century ago, that we could ever get particles smaller than atoms to transmit enormous quantities of energy from place to place? And yet that is what really happens when we send electric power along a stationary wire. Who could have believed that we should ever get these invisible particles to carry our speech to distant towns, and to bring us immediate intelligence of what is happening in all parts of the civilised world?



THE ELECTROSCOPE IN USE

An insulated metal rod with two pieces of gold leaf attached to its lower end is protected by a glass jar. When any electrified body is brought near the metal disc attached to the upper end of the rod, the gold leaves become electrically charged and repel each other, as shown in the lower photograph. The presence of radium may be detected by an electro-scope which has been charged previously, as explained in the text.



REGULAR FIGURES PRODUCED BY FLOATING MAGNETS

In the first photograph the little upright magnetic needles may be seen projecting downwards from the small corks. Left alone, the similar poles repel one another, but in the other photographs the hand holds the opposite pole of a magnet above the centre of the basin, whereupon the little magnets invariably form definite figures according to their number. These experiments enable us to form a mental picture of the construction of the atom.

SCIENTIFIC IDEAS OF TO-DAY

A SIMPLE ACCOUNT OF THE NATURE
OF ATOMS, ELECTRICITY, LIGHT,
HEAT, &c., &c.
IN NON-TECHNICAL LANGUAGE

By

CHARLES R. GIBSON, F.R.S.E.

Author of "Electricity of To-Day," "The Romance of Modern
Electricity," "The Romance of Modern Photography,"
&c. &c.

With Forty-two Illustrations and Diagrams

SEVENTH EDITION, REVISED & BROUGHT UP TO DATE

London

Seeley, Service & Co. Limited
196 Shaftesbury Avenue

MDCCCXXV

SOUND

JOHN TYNDALL, D.C.L., LL.D., F.R.S.



NEW YORK
P. F. COLLIER & SON
MCMV

In the case of a string fixed at one end, the modes of vibration are those of a string fixed at one end. The series of numbers 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000.

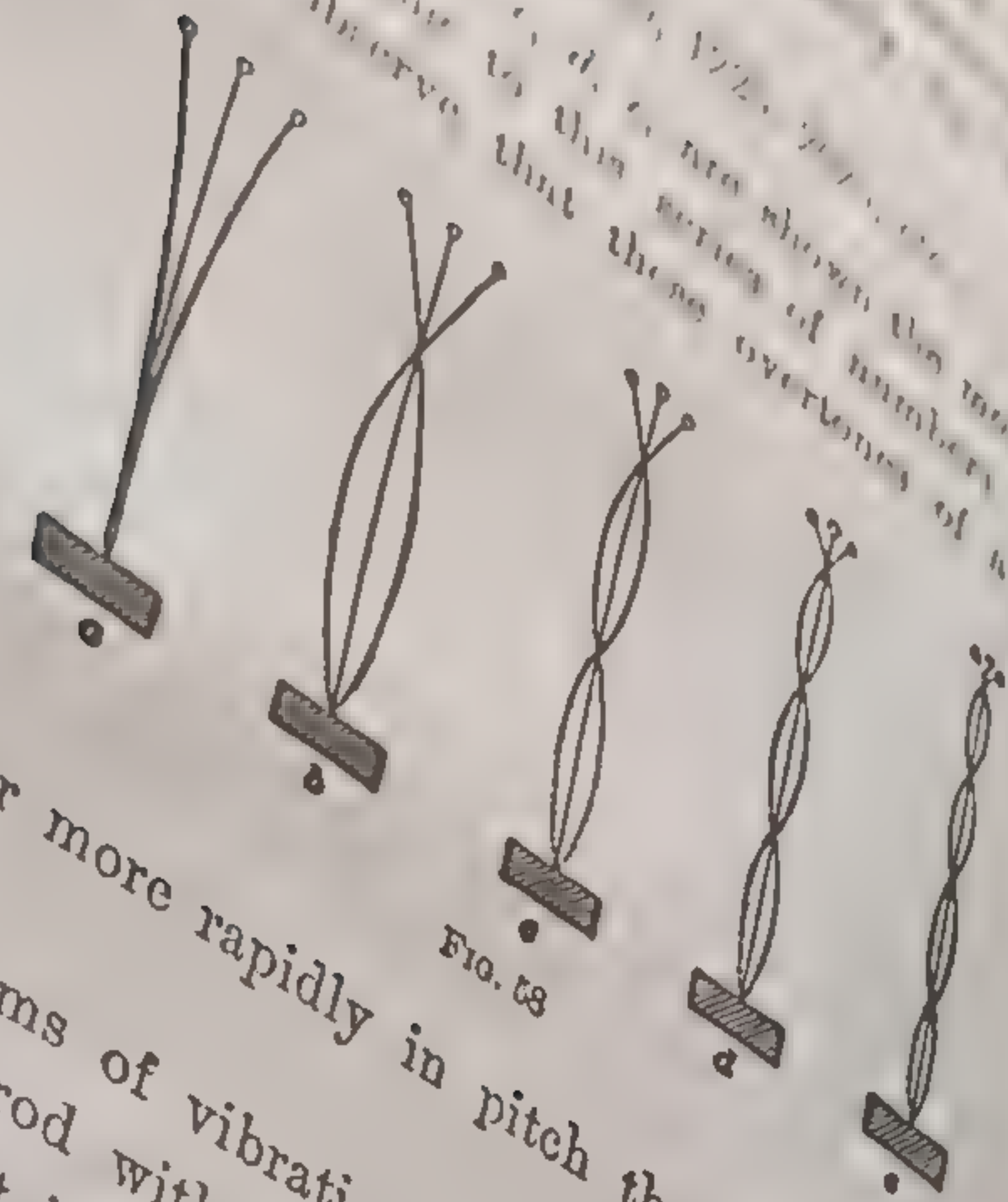


FIG. 58.

rod rise far more rapidly in pitch than the harmonics of a string. Other forms of vibration may be obtained by smartly striking the rod with the finger near its fixed end. In fact, an almost infinite variety of luminous scrolls can be thus produced, the beauty of which may be inferred from the subjoined figures (see next page) first obtained by Sir C. Wheatstone. They may be produced by illuminating the bead with sunlight, or with the light of a lamp or candle. The scrolls, moreover, may be doubled by employing two candles instead of one. Two spots of light then appear, each of which describes its own luminous line when the knitting-needle is set in vibration.

§ 4. Transverse Vibrations of a Rod free at Both Ends. The Claque-bois and Glass Harmonica. From a rod or bar fixed at one end, we will now pass to a rod or bar free at both ends; for such an arrangement we shall become acquainted with the application of his method to the study of transverse vibrations.

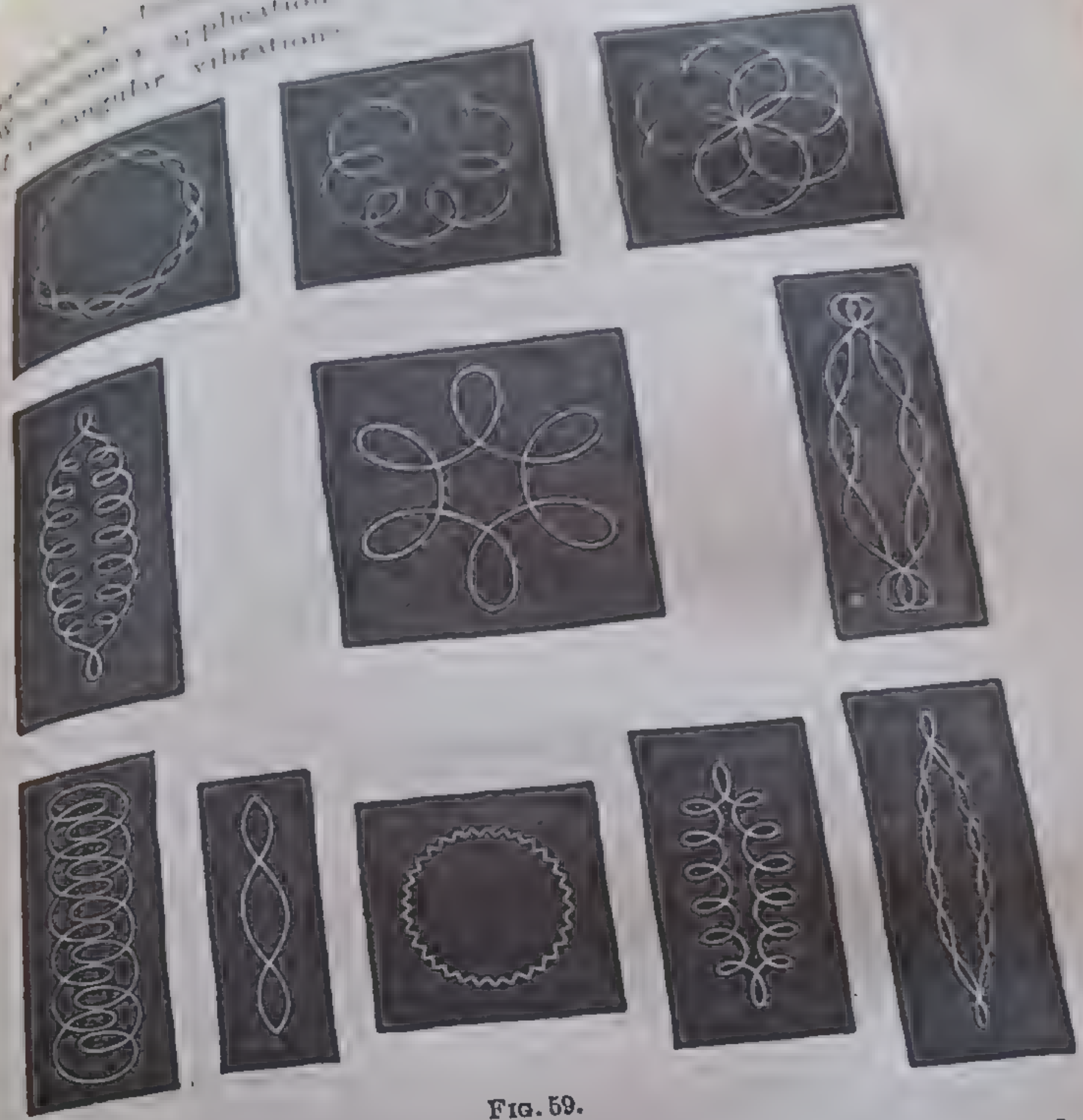


FIG. 59.

§ 4. Transverse Vibrations of a Rod free at Both Ends. The Claque-bois and Glass Harmonica

From a rod or bar fixed at one end, we will now pass to a rod or bar free at both ends; for such an arrangement we shall become acquainted with the application of his method to the study of transverse vibrations.

Other striking forms of fact, an almost instantaneous change of pitch the

spots of light.

Fig. 69.

at Both Ends.

The Claque-ours will

2

IMPROVED CARTRIDGE
FIRE ARMS
AND
MACHINE

SMITH, WINCHESTER & Co.,

SOUTH WINDHAM, CONNECTICUT, U.S.A.

THE OLDEST AND MOST EXTENSIVE ESTABLISHMENT OF THE KIND ON THIS CONTINENT.

HARTFORD, CONN.:
THE CASE, LOCKWOOD & BRAINARD CO., PRINTERS.
1876.

THE
VOLUME II



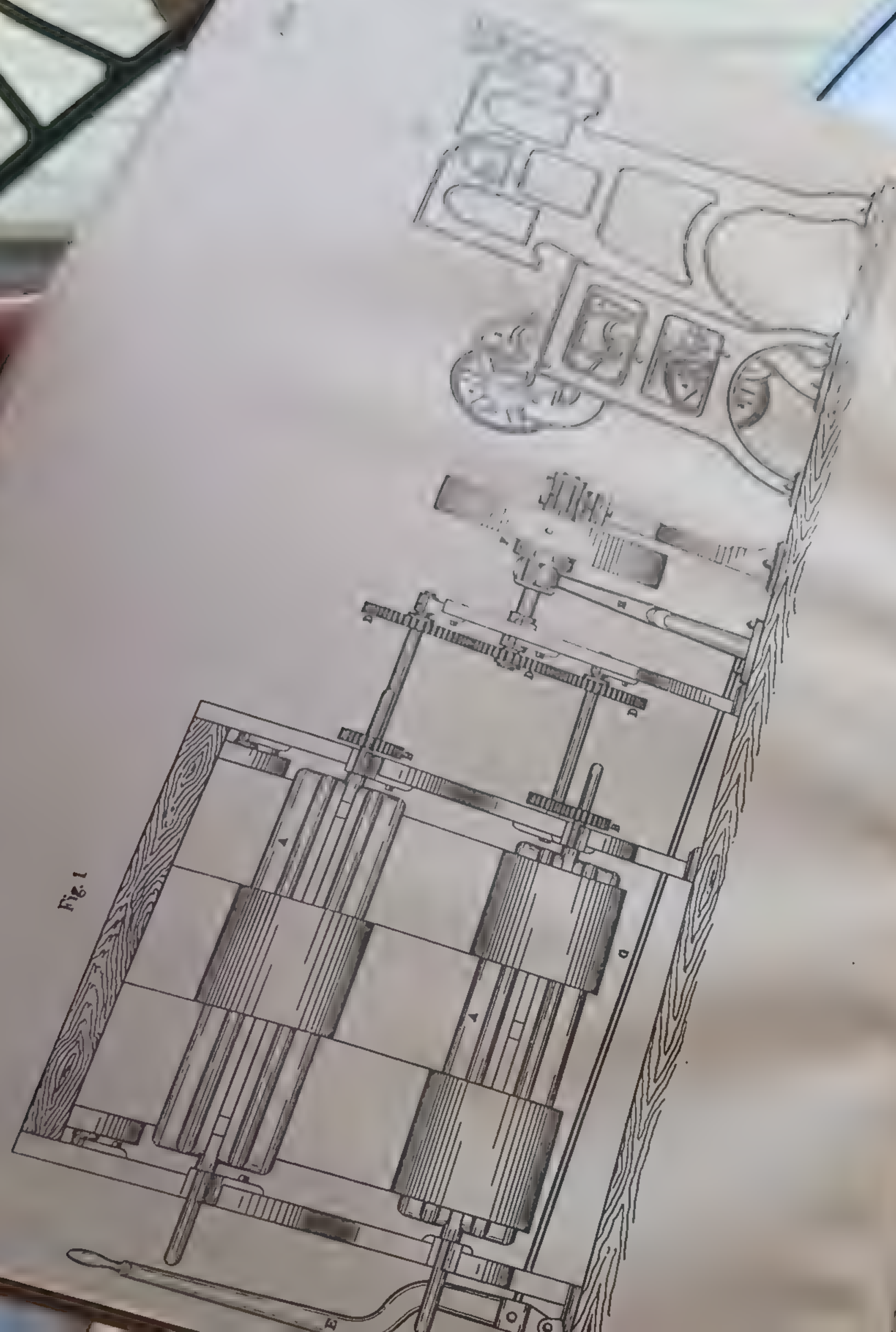


Fig. 1

PLATE No. 19,

Represents a Winder, for winding paper as it comes from the reels. Fig. 1 is front elevation, and Fig. 2, end elevation. A, A are reels, upon which the paper is wound, connected to driving arrangement by gears B, B, as shown in Figs. 1 and 2, thence to pulley C, by means of gears D, D, D, all being put in motion by lever E, from front side of machine, connected to clutch F, by rod and fork H. The sheet is made into three webs by the slitters I, I, Fig. 2, then wound upon reels, as shown.

This arrangement for winder has been found very convenient where winding is done a large portion of the time. It can be attached to almost any cutter, and removed when not required.

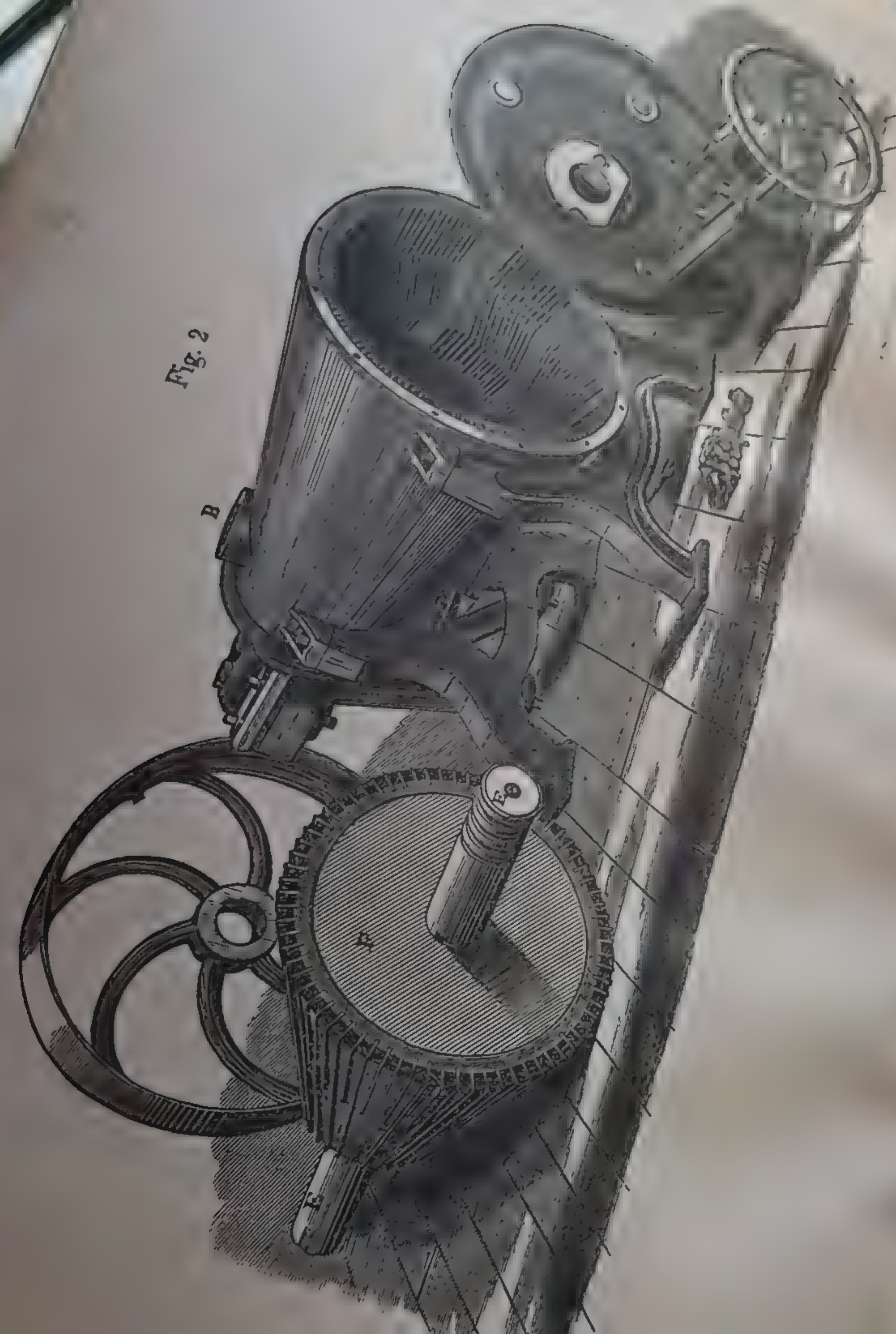


Fig. 2

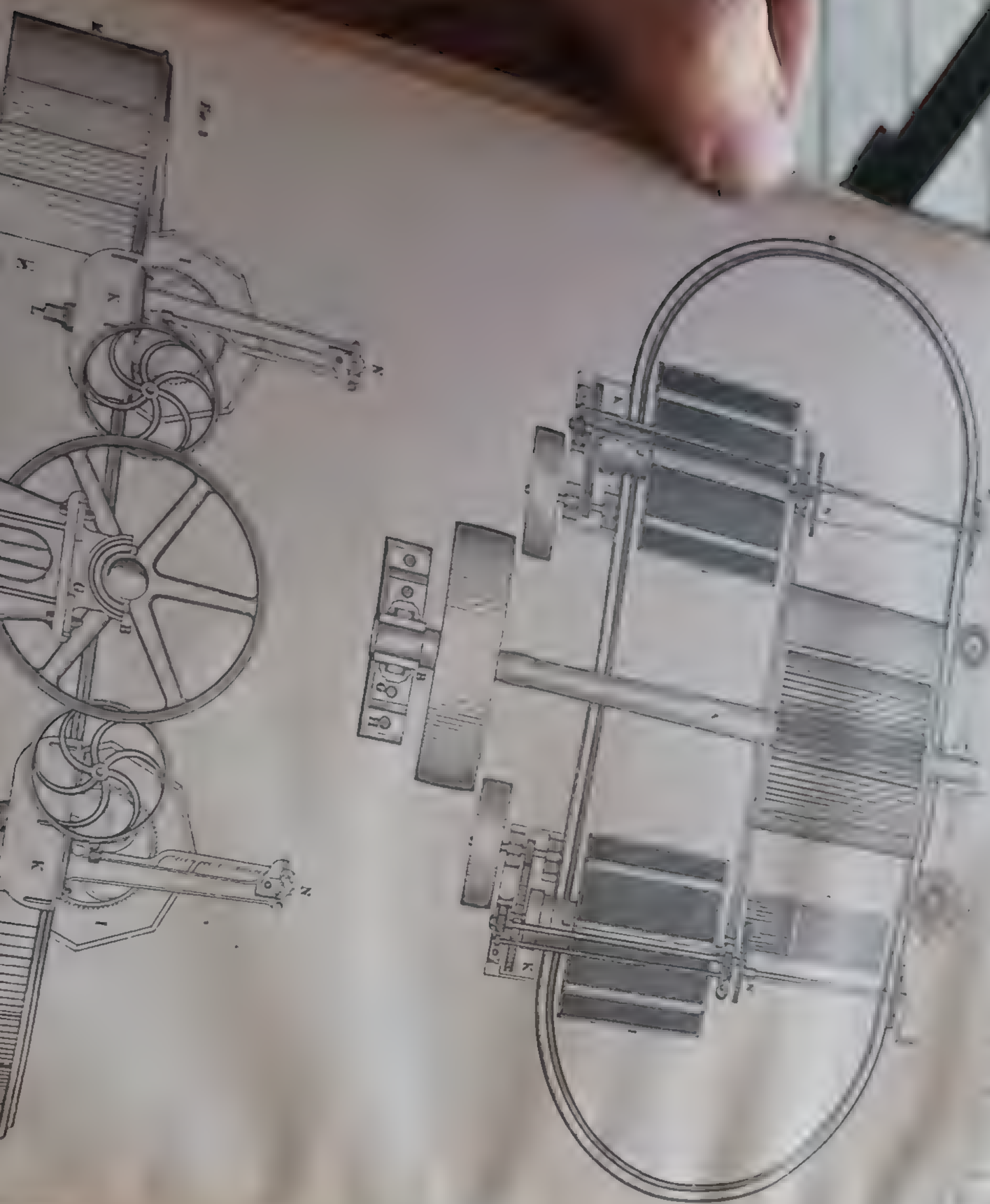
PLATE Nos. 11 and 13,

Represent a Jordan & Eustice Patent Beating Engine, used for the purpose of clearing paper stock after it has been three-quarters beaten. Fig. 1 represents the machine when together, ready for use. Fig. 2 represents the machine when taken apart. A, Fig. 1, represents a stuff box, or receptacle for the stuff when pumped from chest or reservoir. The stuff enters at the point B, as indicated on Fig. 2, and is discharged at the point C, Fig. 1. We show pulley D, for driving, attached to shaft E, E, Figs. 1 and 2, upon which a cast iron cone F, is attached, filled with knives, as shown. We also show the knives in shell, Fig. 2.

The machine having been put together as seen in Fig. 1, and having been adjusted properly, the internal cone F, Fig. 2, is forced laterally by means of the hand wheel and screw G, Fig. 1.

The operation of this machine is so well liked by all who see them running, that nearly all mills upon book and news papers are adopting them as the best machines for clearing the stock, as nothing passes through this machine without being brushed.

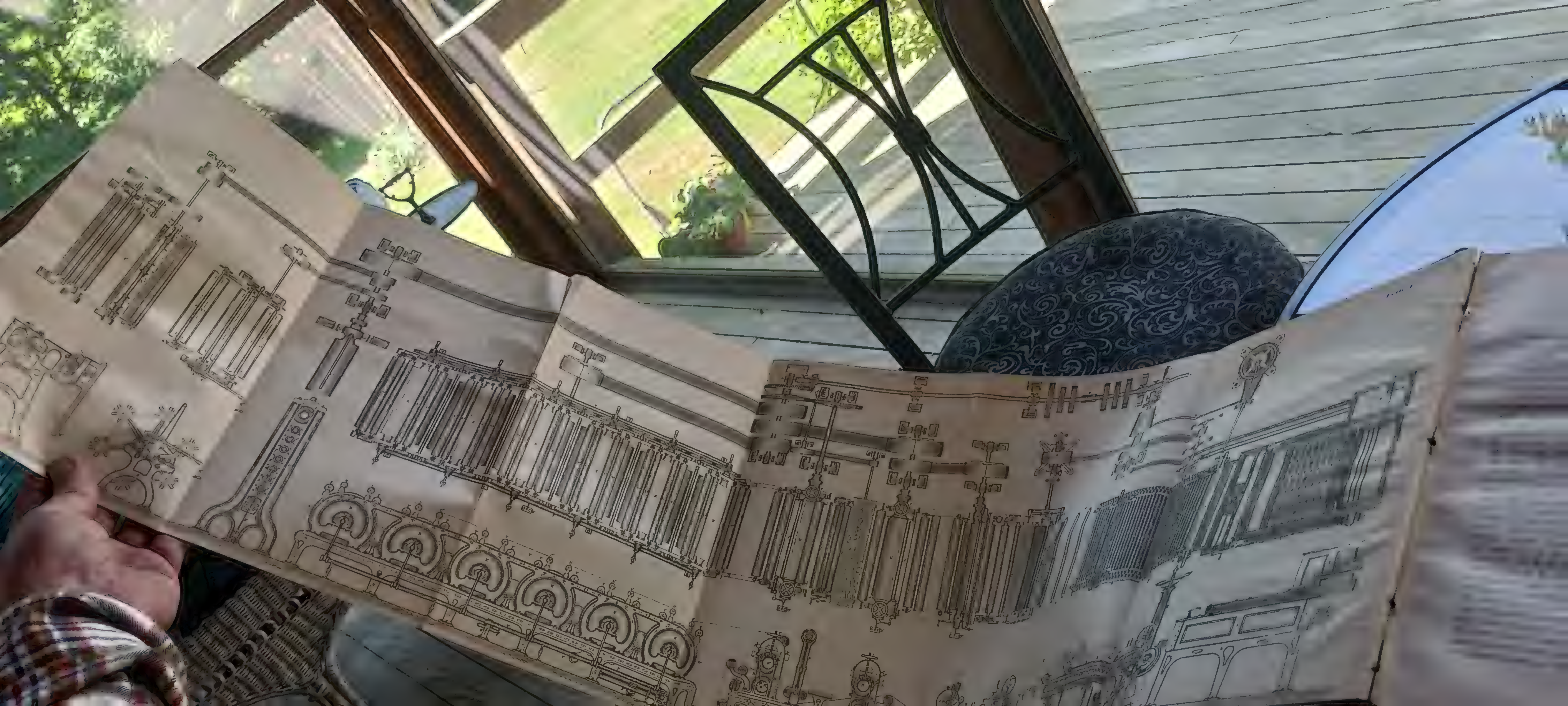
We can recommend this machine above all others, to parties wishing a clear, uniform pulp, and perfect paper.



1, 2, and 3 (which is made of wood or iron as desired, and after the stock has been agitated by the roll or knives upon the bed-plate, as represented in Fig. 1, the washers are lowered into place by means of the rack and gears N, N, Figs. 1, 2, and 3, when the dirty water is at once discharged as described above. When the washers are not required, they may be raised out of the stuff entirely by the same process, racks and gear as described.

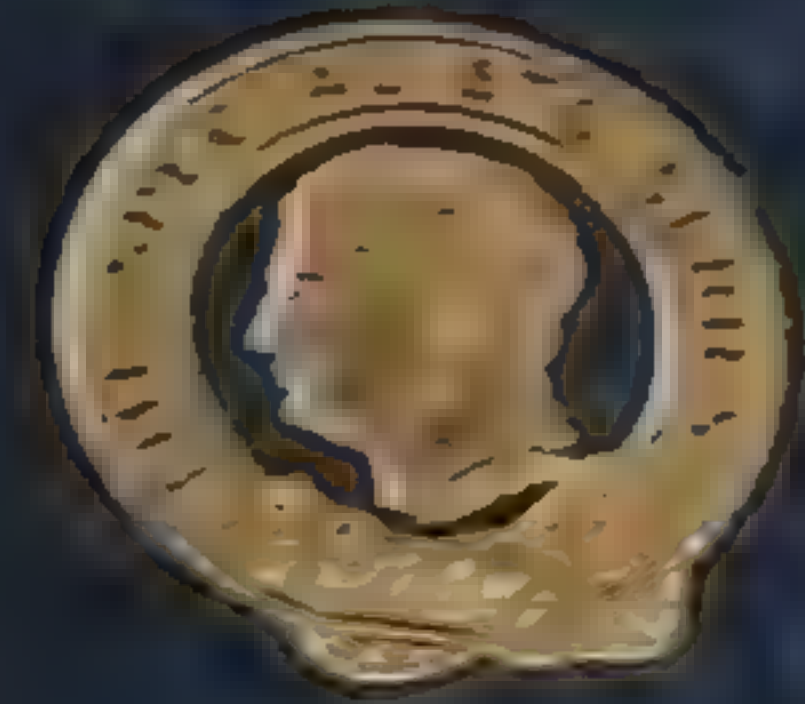
O, Figs. 1 and 2, represents a screen made of iron, for the purpose of collecting sand or other hard substances that would ordinarily settle at the bottom of the stuff.





TELEPHONY

VOLUME II



HERBERT
AND PROCTER

TELEPHONY

VOLUME I



HERBERT
AND PROCTER





A MODERN CENTRAL BATTERY MANUAL TELEPHONE EXCHANGE

Frontispiece

TELEPHONY

A DETAILED EXPOSITION OF THE
TELEPHONE SYSTEM OF THE BRITISH
POST OFFICE

BY

T. E. HERBERT, M.I.E.E.

SUPERINTENDING ENGINEER, POST OFFICE ENGINEERING DEPARTMENT

AND

W. S. PROCTER, A.M.I.E.E.

ENGINEER IN-CHIEF'S OFFICE, POST OFFICE ENGINEERING DEPARTMENT
ASSISTANT EDITOR, "POST OFFICE ELECTRICAL ENGINEERS' JOURNAL"

SECOND EDITION

VOLUME I

MANUAL SWITCHING SYSTEMS AND LINE PLANT

THE NEW ERA PUBLISHING CO., LTD.
12 & 14 NEWTON STREET, HOLBORN, LONDON, W.C.2

It will be seen, then, that the instrument for the commercial transmission of sound may be divided into two broad classes, viz. those which generate a current as a result of the reception of sound waves, and those which modify the electrical characteristics of a circuit when they receive sound waves. The former type is much more efficient as regards the quality of the reproduced sound and when used in conjunction with an amplifier, as in certain transmitting arrangements employed in broadcasting studios, etc.

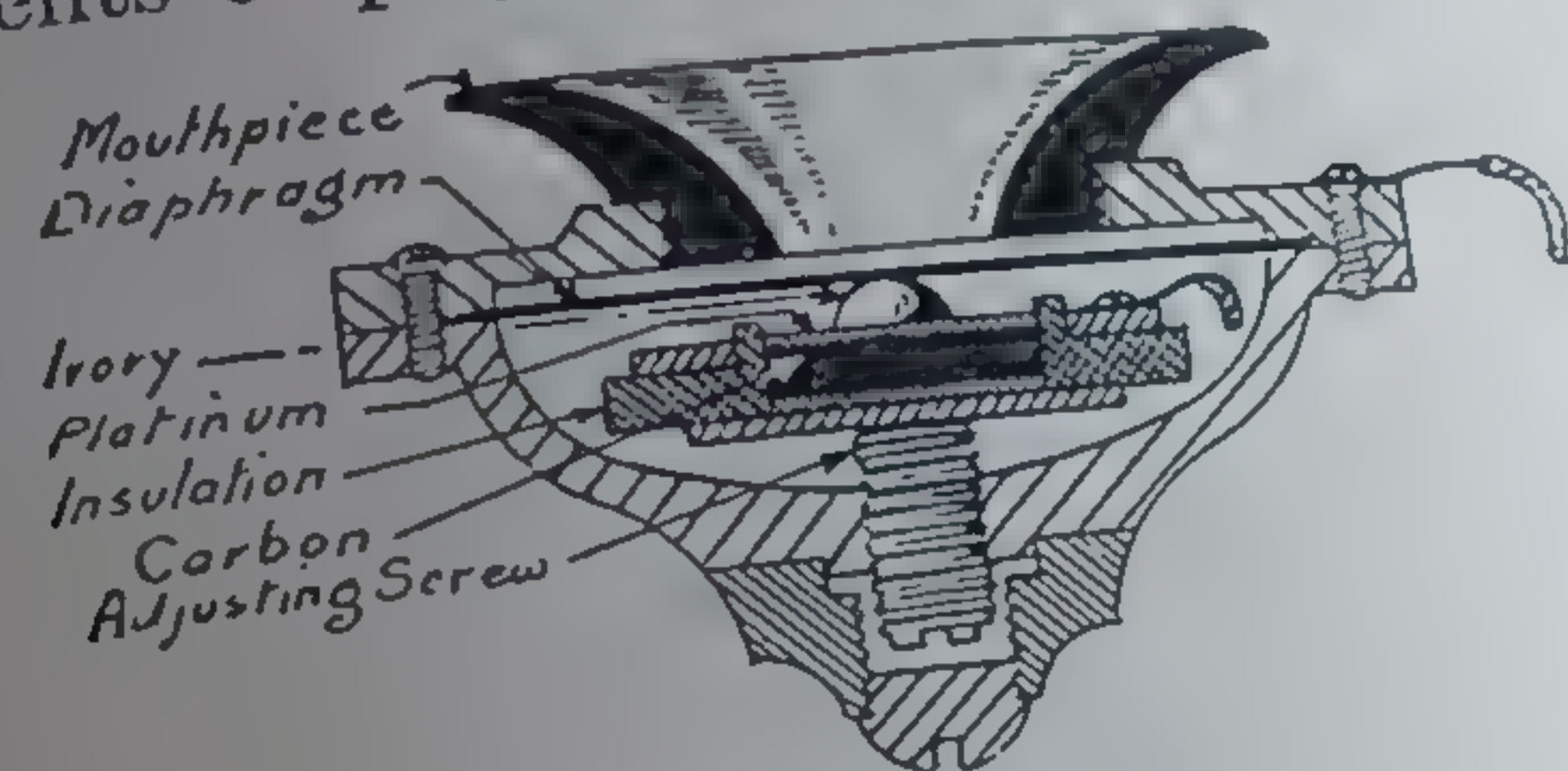


FIG. 112. EDISON TRANSMITTER

the difficulties encountered in the early days of telephony are overcome.

Definition. In telephony, a transmitter is defined as "an electro-mechanical device designed to convert sound waves or vibrations into electrical waves or vibrations for transmission over a telephone or other circuit."¹

In the Edison transmitter (Fig. 112), the circular ferrotype diaphragm rests upon an ivory button attached to the upper plate of the pair between which the disc of lamp-black (carbon) is contained. A table provided with a screw serves to carry the arrangement in adjustment of the steady mechanical

communicated to the upper platinum plate which, by varying the pressure on the carbon disc about the steady value, varies the resistance of the instrument between the two platinum plates forming the terminals of the transmitter. It is now well recognized that the action depends, not upon the reduction in the resistance of the carbon due to compression, but upon the variation in the resistance of the area of contact between the carbon plates and the platinum.

In May, 1878, Professor Hughes read his historic

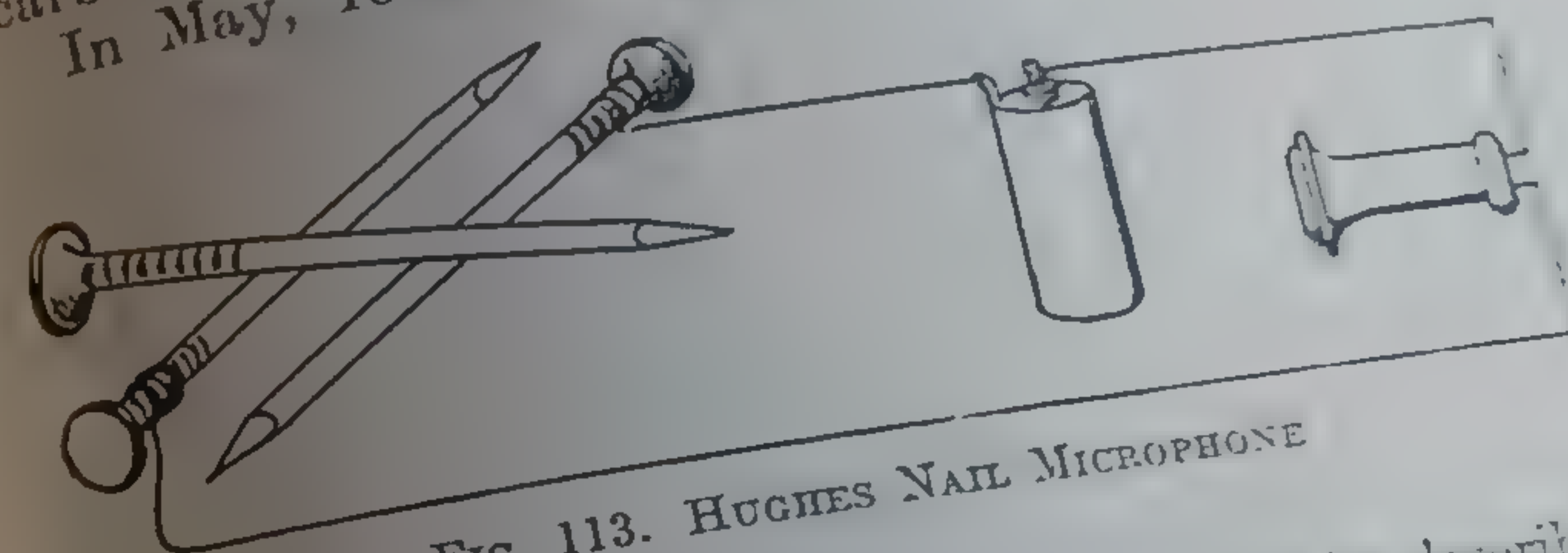


FIG. 113. HUGHES NAIL MICROPHONE

paper before the Royal Society, in which he described his discovery that any system of loose contacts will form a telephone transmitter. Three iron nails joined up in circuit with a battery and a receiver, as shown in Fig. 113, are capable of transmitting speech. To all such instruments he gave the generic title of "microphone," owing to his belief that the original sounds were amplified.

Definition. In telephony a microphone is defined as "a transmitter designed to have its electrical resistance directly and materially altered by slight differences in mechanical pressure such as are caused by sound waves or vibrations."²

The fundamental principle of the action of a microphone lies in the fact that loose contacts vary in resistance when the members are thrown into vibration by sound waves. After many experiments, Professor

magnetic field, and the highest value of the E.M.F. is therefore generated at the moment when the plane of the coil lies along the magnetic field. For, if the motion of any conductor be considered, it is cutting the lines at the greatest rate at the instant when it is opposite to the middle of the N. pole, its motion at that instant being practically parallel to the pole. When it has moved through 45° , it is moving at the angle to the field and the rate of cutting is less; at the

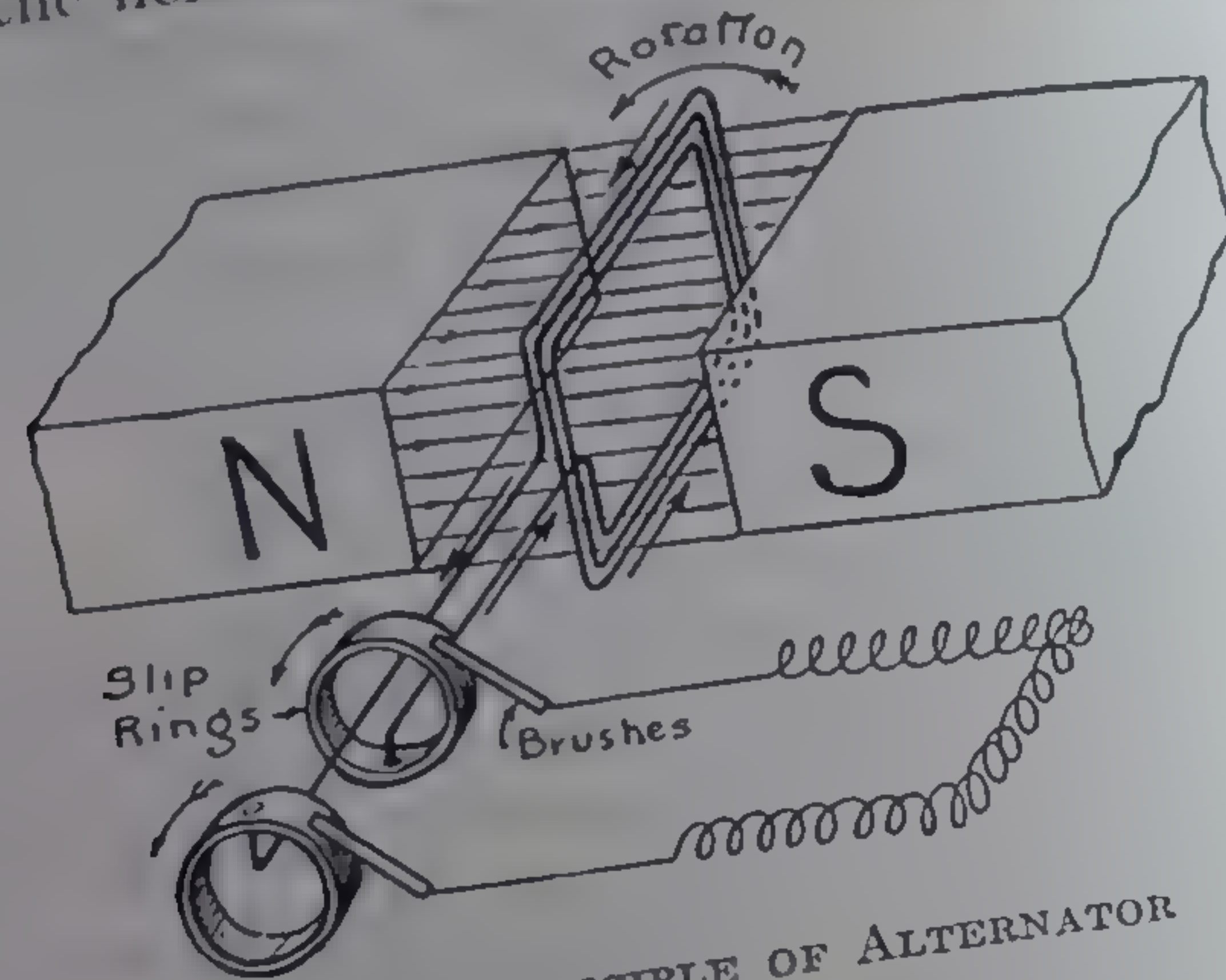


FIG. 22. PRINCIPLE OF ALTERNATOR

top of the field, the conductor is moving along the lines, and the E.M.F. generated at this instant is nil. As the conductor passes over the top, it commences to cut the field in the opposite direction, and the E.M.F. in the reverse direction begins and grows in strength until, when the conductor is opposite to the centre of the S. pole, it reaches a maximum. From this point it decreases until at the bottom of the field it is again zero. The number of lines

exemplified by the "generator" which is used in telephony. In reality, it is the same as the magneto-electric machine of 1857, made to generate and minus the commutator.

The generator usually consists of three horseshoe magnets whose poles of like polarity are joined by two hollowed soft iron pole pieces, between

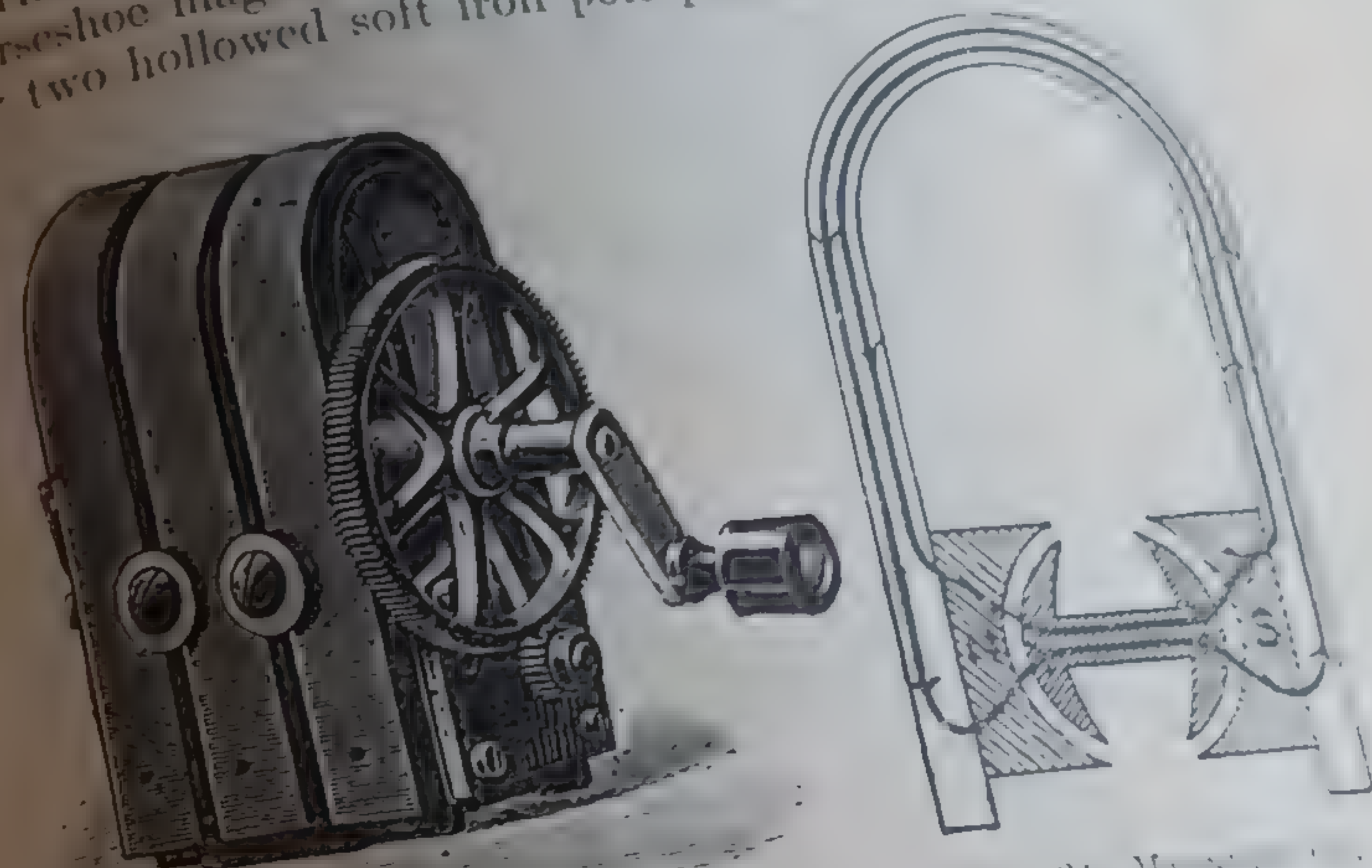


FIG. 23. A MAGNETO GENERATOR

FIG. 24. MAGNETO GENERATOR
CROSS SECTION

is placed a revolving armature of soft iron wound with a suitable number of turns of fine, silk-covered copper wire. The instrument as a whole is illustrated in Fig. 23, and constructional sketches are given in Figs. 24 and 25. The armature is of the well-known H-form, and the coil is wound on the central web. When the armature occupies the position shown in Fig. 24, the lines of force pass through the central web in the general direction shown by the two heavy lines. When the position of the armature with respect to the magnet is changed, the position of the lines with respect to the armature is altered, thereby generating an E.M.F.



















